Errata

Title & Document Type: **8654B Signal Generator Operating and Service Manual**

Manual Part Number: **08654-90025**

Revision Date: **March 1977**

About this Manual

We've added this manual to the Agilent website in an effort to help you support your product. This manual provides the best information we could find. It may be incomplete or contain dated information, and the scan quality may not be ideal. If we find a better copy in the future, we will add it to the Agilent website.

HP References in this Manual

This manual may contain references to HP or Hewlett-Packard. Please note that Hewlett-Packard's former test and measurement, life sciences, and chemical analysis businesses are now part of Agilent Technologies. The HP XXXX referred to in this document is now the Agilent XXXX. For example, model number HP8648A is now model number Agilent 8648A. We have made no changes to this manual copy.

Support for Your Product

Agilent no longer sells or supports this product. You will find any other available product information on the Agilent Test & Measurement website:

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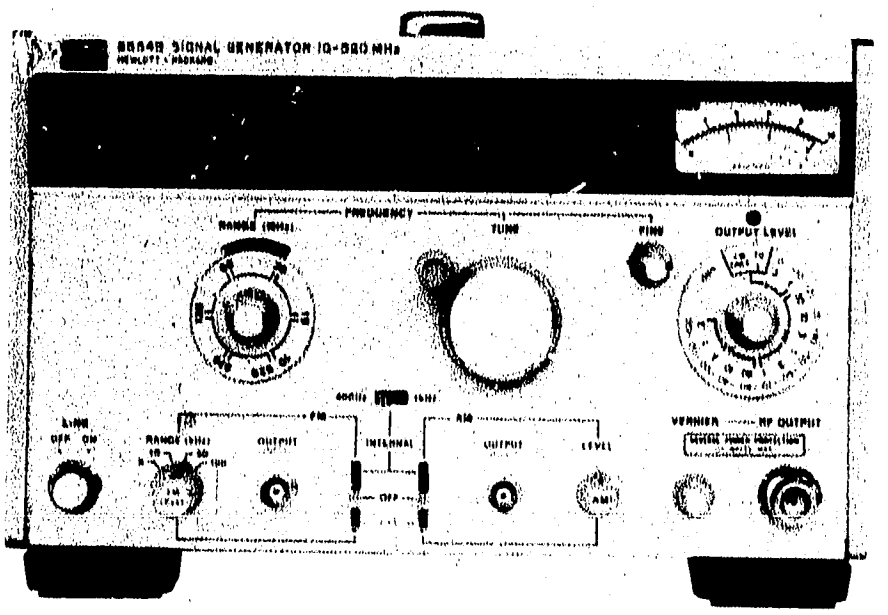
Search for the model number of this product, and the resulting product page will guide you to any available information. Our service centers may be able to perform calibration if no repair parts are needed, but no other support from Agilent is available.

Agilent Technologies

HP 8654B

OPERATING AND SERVICE MANUAL

8654B
SIGNAL GENERATOR



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HP 8654B

CERTIFICATION

The Hewlett-Packard Company certifies that this instrument met its published specifications at the time of shipment from the factory. Hewlett-Packard Company further certifies that its calibration measurements are traceable to the United States National Bureau of Standards, to the extent allowed by the Bureau's calibration facility, and to the calibration facilities of other International Standards Organization members.

WARRANTY AND ASSISTANCE

This Hewlett-Packard product is warranted against defects in materials and workmanship for a period of one year from the date of shipment. Hewlett-Packard will, at its option, repair or replace products which prove to be defective during the warranty period provided they are returned to Hewlett-Packard, and provided the preventive maintenance procedures in the manual are followed. Repairs necessitated by misuse of the product are not covered by this warranty. NO OTHER WARRANTIES ARE EXPRESSED OR IMPLIED, INCLUDING, BUT NOT LIMITED TO, THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE. HEWLETT-PACKARD IS NOT LIABLE FOR CONSEQUENTIAL DAMAGES.

Service contracts or customer assistance agreements are available for Hewlett-Packard products.

For any assistance, contact your nearest Hewlett-Packard Sales and Service Office. Addresses are provided at the back of this manual.

HEWLETT hp PACKARD

OPERATING AND SERVICE MANUAL

8654B
SIGNAL GENERATOR

(Including Option 003)

SERIAL NUMBERS

This manual applies directly to instruments with serial numbers prefixed 1710A.

For additional important information about serial numbers, see INSTRUMENTS COVERED BY MANUAL in Section I.

With changes described in Section VII, this manual also applies to instruments with serial numbers prefixed 1512A, 1521A, 1529A, 1531A, 1532A, 1550A, 1612A, 1633A, 1638A, and 1647A.

1501 PAGE MILL ROAD, PALO ALTO, CALIFORNIA, U. S. A.

MANUAL PART NO. 08654-90025
Microfiche Part No. 08654-90026
Operating Supplement Part No. 08654-90027

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SAFETY CONSIDERATIONS

GENERAL

This product and related documentation must be reviewed for familiarization with safety markings and instructions before operation. This product has been designed and tested in accordance with international standards.

SAFETY SYMBOLS

Instruction manual symbol: the product will be marked with this symbol when it is necessary for the user to refer to the instruction manual (refer to Section II of this manual.

Indicates hazardous voltages.

Indicates earth (ground) terminal.

WARNING

The WARNING sign denotes a hazard. It calls attention to a procedure, practice, or the like, which, if not correctly performed or adhered to, could result in personal injury. Do not proceed beyond a WARNING sign until the indicated conditions are fully understood and met.

CAUTION

The CAUTION sign denotes a hazard. It calls attention to an operating procedure, practice, or the like, which, if not correctly performed or adhered to, could result in damage to or destruction of part or all of the product. Do not proceed beyond a CAUTION sign until the indicated conditions are fully understood and met.

SAFETY EARTH GROUND

This is a Safety Class I product (provided with a protective earthing terminal). An uninterruptible safety earth ground must be provided from the main power source to the product input wiring terminals, power cord, or supplied power cord set. Whenever it is likely that the protection has been impaired, the product must be made inoperative and be secured against any unintended operation.

BEFORE APPLYING POWER

Verify that the product is configured to match the available main power source per the input power configuration instructions provided in this manual.

If this product is to be energized via an auto-transformer make sure the common terminal is connected to the neutral (grounded side of mains supply).

SERVICING

WARNINGS

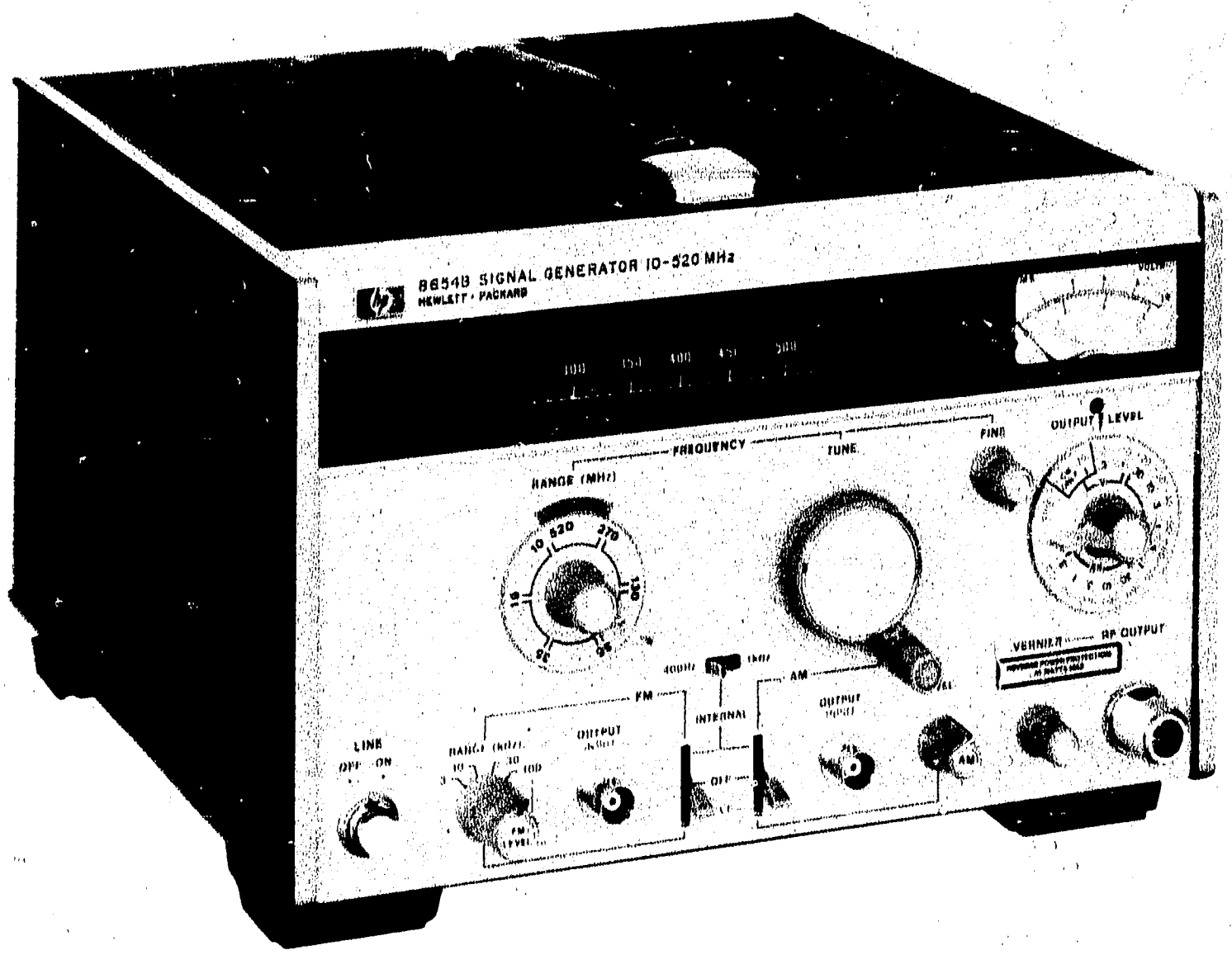
Any servicing, adjustment, maintenance, or repair of this product must be performed only by qualified personnel.

Adjustments described in this manual may be performed with power supplied to the product while protective covers are removed. Energy available at many points may, if contacted, result in personal injury.

Capacitors inside this product may still be charged even when disconnected from its power source.

To avoid a fire hazard, only fuses with the required current rating and of the specified type (normal blow, time delay, etc.) are to be used for replacement.

MODEL 8654B



POWER CABLE

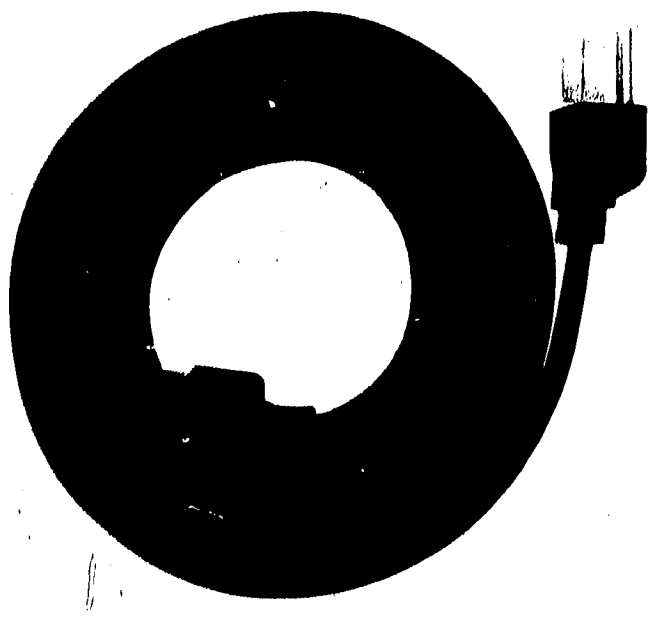


Figure 1-1. HP Model 8654B Signal Generator with Option 003 and Power Cable

SECTION I
GENERAL INFORMATION

1-1. INTRODUCTION

1-2. This manual contains information pertaining to installation, operation, testing, adjustment, and maintenance of the Model 8654B Signal Generator. Figure 1-1 shows the Hewlett-Packard Model 8654B Signal Generator with Reverse Power Protection, Option 003, and the instrument power cable.

1-3. The information in this manual is divided into sections as shown below:

Section I, GENERAL INFORMATION, describes the instruments documented by this manual and covers instrument identification, description, accessories, specifications, and other basic information.

Section II, INSTALLATION, provides information about incoming inspection, power requirements, mounting, storage, and shipping of the instrument.

Section III, OPERATION, provides information about panel features, and gives operating checks, instructions, and maintenance information.

Section IV, PERFORMANCE TESTS, provides information required to ascertain that the instrument is performing in accordance with published specifications.

Section V, ADJUSTMENTS, provides information required to properly adjust and align the instrument after repairs are made.

Section VI, REPLACEABLE PARTS, provides ordering information for replaceable parts and assemblies.

Section VII, MANUAL CHANGES, provides manual change information necessary to document all prefixes listed on the title page. In addition, this section also contains recommended modifications for the earlier instrument configurations.

Section VIII, SERVICE, includes information required to troubleshoot and repair the instrument.

1-4. Packaged with this manual is an Operating Information Supplement. This is simply a copy of the first three sections of this manual. Additional copies of the Operating Information Supplement may be ordered separately through your nearest Hewlett-Packard office. The part number is listed on the title page of this manual.

1-5. Also listed on the title page of this manual, below the manual part number, is a "Microfiche" part number. This number may be used to order 10 x 15 cm (4 x 6-inch) microfilm transparencies of the manual. Each microfiche contains up to 96 photo duplicates of the manual pages. The microfiche package also includes the latest Manual Changes supplement as well as all pertinent Service Notes.

1-6. SPECIFICATIONS

1-7. Instrument specifications are listed in Table 1-1. These specifications are the performance standards or limits against which the instrument may be tested.

1-8. INSTRUMENTS COVERED BY MANUAL

1-9. This instrument has a two-part serial number. The first four digits and the letter constitute the serial number prefix, which denotes the instrument's configuration. The last five digits form the suffix that is unique to each instrument. The contents of this manual apply directly to instruments having the same serial number prefix as listed under SERIAL NUMBERS on the title page.

1-10. An instrument manufactured after the printing of this manual may have a serial number that is not listed on the title page. This unlisted serial number prefix indicates that the instrument is different from those documented in this manual. The manual for this instrument is supplied with a Manual Changes supplement that contains change information that documents the differences.

1-11. In addition to change information, the supplement may contain information for correcting errors in the manual. To keep this manual as current and accurate as possible, Hewlett-Packard recommends that you periodically request the latest Manual Changes supplement. The supplement for this manual is keyed to this manual's

Instruments Covered by Manual (Cont'd)
print date and part number, both of which appear on the title page. Complimentary copies of the supplement are available from Hewlett-Packard.

1-12. For information concerning a serial number prefix not listed on the title page or in the Manual Changes supplement, contact your nearest Hewlett-Packard office.

1-13. DESCRIPTION

1-14. The HP 8654B Signal Generator is a portable, solid-state RF source providing calibrated and leveled signals from 10 to 520 MHz, and from +10 to −130 dBm (+8 to −130 dBm with Option 003). An internal oscillator provides calibrated amplitude and frequency modulation at 400 and 1000 Hz. Calibrated modulation from an external source is also possible. A front-panel meter indicates output level, percent AM, or FM peak frequency deviation.

1-15. OPTIONS

1-16. Option 003 adds internal reverse power protection for the Signal Generator's output circuitry (guaranteed to protect against reverse power up to 25 watts). The protection circuit uses a limiter and relay to prevent damage to the output circuitry and to automatically restore generator operation when reverse power is removed. Option 003 also protects the instrument when the LINE switch is off.

1-17. EQUIPMENT AVAILABLE

1-18. Information may be obtained on the accessories and equipment, or they may be ordered by contacting your nearest Hewlett-Packard office. Refer to the HP model number.

1-19. Complementary Equipment

1-20. Modulation Oscillator. The HP Model 651B Test Oscillator is fully compatible for external modulation of the Signal Generator.

1-21. Output Amplifier. The HP Model 8447C Power Amplifier is suitable for increasing the output level of the Signal Generator to >+17 dBm. Typical gain is 30 dB. Typical 3-dB bandwidth is 10—400 MHz.

1-22. Output Amplifier. The HP Model 8447E Power Amplifier is suitable for increasing the output level of the Signal Generator to >+15 dBm. Typical gain is 22 dB. Typical 3-dB bandwidth is 0.05 to 1400 MHz.

1-23. Synchronizer/Counter. The HP Model 8655A Synchronizer/Counter is designed to monitor and phase lock the output frequency of the Signal Generator. Maximum counter resolution over the generator's frequency range is 100 Hz. Maximum counter resolution when phase locked to the 8654B is 500 Hz.

1-24. Accessories

1-25. Termination. The HP Model 11507A Output Termination may be used to match the Signal Generator's 50-ohm output to low impedance circuits (5 ohms minimum), or to allow the generator to drive high impedance circuits at frequencies to 65 MHz. The termination may also be used as a dummy antenna for receiver measurements.

1-26. 75-Ohm Adapter. The HP Model 11687A 50 to 75-ohm Adapter may be used to match the Signal Generator output to a 75-ohm load. The OUTPUT LEVEL dial and meter scale remain calibrated in volts, but a correction factor is necessary to read output calibrated in dBm.

1-27. Frequency Doubler. The HP Model 11690A Frequency Doubler extends the usable range of signal sources to 1 GHz. Conversion loss is <13 dB.

1-28. Mixer. The HP Model 10514A Double Balanced Mixer may be used as a current controlled attenuator, an amplitude, pulse, or square-wave modulator, or a phase detector.

1-29. Transit Case. A transit case is available to protect the Signal Generator while transporting it from location to location. The case meets the requirements of MIL-C-4150 and may be ordered by specifying HP part number 9211-1895.

1-30. SERVICE AND USER AIDS

1-31. Video Tapes. Video tapes covering instrument use, application, and service are available. Contact the nearest Hewlett-Packard Sales and Service office for a list of presently available tapes.

1-32. Application Notes. Informative notes concerning the use of signal generators are also available from the nearest Hewlett-Packard Sales and Service office.

1-33. Service Notes. Hewlett-Packard makes design improvements to its current line of instruments on a continuing basis. Many of these improvements can be incorporated into earlier produced instru-

Service and User Aids (Cont'd)
ments. Modification and general service information is passed on in the form of Service Notes. To obtain the Service Notes contact the nearest Hewlett-Packard Sales and Service office.

1-34. WARRANTY

1-35. The Signal Generator is warranted and certified as indicated on the inner front cover of this manual. For further information, contact the nearest Hewlett-Packard Sales and Service office; addresses are provided at the back of this manual.

1-36. RECOMMENDED TEST EQUIPMENT

1-37. The equipment recommended for performance testing, adjustments, and troubleshooting is listed in Table 1-2. Only equipment that meets or exceeds the critical specifications should be used in place of that shown in the table.

NOTE

The 8654B is a safety class I instrument. It has been manufactured and tested in accordance with international standards. This instrument and all related documentation must be reviewed for familiarization with safety markings and instructions before operation. Refer to the Safety Considerations page found at the beginning of this manual for a summary of the safety information. Safety information pertinent to the task at hand (installation, operation, performance testing, adjustments, or service) is found throughout this manual.

Table 1-1. Specifications (1 of 2)

SPECIFICATIONS

Specifications apply from 10 to 520 MHz for output power ≤+10 dBm and over the top 10 dB of output level vernier range unless otherwise specified.

FREQUENCY CHARACTERISTICS

Range: 10 to 520 MHz in 6 ranges:
10 to 19 MHz
19 to 35 MHz
35 to 66 MHz
66 to 130 MHz
130 to 270 MHz
270 to 520 MHz

Accuracy: ±3% after 2-hour warm-up.

Settability: Settable to within 5 ppm of the desired frequency with an external indicator after 1-hour warm-up.

Stability (after 2-hour warm-up and 15 min. after frequency change): <(1 kHz plus 20 ppm)/5 min.

SPECTRAL PURITY

Harmonic Distortion (output power ≤+3 dBm):
>20 dB below carrier (dBc).
Option 003: >15 dBc.

Subharmonics and Non-harmonic Spurious (excluding line related): >100 dBc.

Residual AM (average rms): >55 dBc in a 50 Hz to 15 kHz post-detection noise bandwidth.

Residual FM on CW (averaged rms deviation):
<0.3 ppm in a 0.3 to 3 kHz post-detection noise bandwidth. <0.5 ppm in a 50 Hz to 15 kHz post-detection noise bandwidth.

OUTPUT CHARACTERISTICS

Range: 10 dB steps and a 13 dB vernier provide power settings from +10 dBm to −130 dBm (0.7V to 0.07 μV) into 50Ω. For Option 003, maximum output level is +8 dBm (0.56V).

Impedance: 50Ω ac coupled. SWR <1.3 on 0.1V range or lower. With Option 003, SWR <1.5 on 0.1V range or lower.

Level Accuracy:

	Using Top 10 dB of Vernier Range				Using Full Vernier Range
Output Level (dBm)	+10* to −7	−7 to −57	−57 to −97	−97 to −127	+10* to −130
Total Accuracy as Indicated on Level Meter (dB)	±1.5	±2.0	±2.5	±3.0	Add ±0.5

Note: Level Accuracy error consists of allowances for meter accuracy, detector linearity, temperature, flatness, attenuator accuracy, and twice the measurement error. All but the attenuator accuracy and the measurement error can be calibrated out with a power meter at a fixed frequency and a fixed vernier setting.

*For Option 003, maximum output level is +8 dBm (0.56V).

Level Flatness: ±1 dB referenced to the output at 250 MHz for output levels > −7 dBm.

Table 1-1. Specifications (2 of 2)

SPECIFICATIONS

OUTPUT CHARACTERISTICS (cont'd)

Auxiliary RF Output: > −7 dBm (100 mV) into 50Ω.

Leakage (with all RF outputs terminated properly):
Leakage limits are below those specified in MIL-I-6181D. Furthermore, with an output level <0.01V, less than 0.5 μV is induced in a 2-turn, 25 mm (1-inch) diameter loop 25 mm (1 inch) away from any surface and measured into a 50Ω receiver.

Reverse Power Damage Level:
75 Vdc maximum. Output Range 1V and 0.3V: 250 mW (+24 dBm). All other output ranges: 500 mW (+27 dBm).

Reverse Power Protection (Option 003): Protects signal generator from accidental applications of up to 25W (+44 dBm) of RF power (between 10 and 520 MHz) into generator output.

MODULATION CHARACTERISTICS

Amplitude Modulation: Specifications apply for output power <+3 dBm.[1]

Depth: 0 to 90%.

Modulation Rate:
Internal, 400 and 1000 Hz ±10%.
External 3 dB bandwidth, dc-coupled to >20 kHz.

External AM Sensitivity:[2] (0.1 ± 0.01)% AM/mVpk into 600Ω, with AM LEVEL vernier at fully cw position.

Indicated AM Accuracy:[2] ±(5% of reading +5% of full scale).

Peak Incidental Frequency Deviation (30% AM)[2]: less than 200 Hz.

Envelope Distortion:[2] <3%, 0 to 70% modulation; <5%, 70 to 90% modulation.

Frequency Modulation: fully calibrated.

Peak Deviation:
0 to 30 kHz from 10 to 520 MHz.
0 to 100 kHz from 80 to 520 MHz.

Deviation Ranges: 0 to 3 kHz, 0 to 10 kHz, 0 to 30 kHz, 0 to 100 kHz.

Modulation Rate:
Internal, 400 to 1000 Hz ±10%.
External 3 dB bandwidth, dc coupled to >25 kHz.

FM Distortion:[2] <2% for deviations up to 30 kHz, <3% for deviations up to 100 kHz.

External FM Sensitivity:[2] 1 volt peak yields maximum deviation indicated on peak deviation meter with FM LEVEL vernier at fully cw position.

Sensitivity Accuracy (15° to 35°C)[2]: ±12%. For 100 kHz deviation range above 130 MHz, ±15%.

Indicated FM Accuracy (15° to 35°C)[2]: ±(12% of reading +3% of full scale). For 100 kHz deviation range above 130 MHz, add 3% of reading.

Incidental AM:[2] < 1% AM at 30 kHz deviation.

GENERAL CHARACTERISTICS

Power: 100, 120, 220, or 240 volts +5%, −10%, 48 to 440 Hz; 25VA maximum, 2.29 m (7½ ft) power cable furnished with mains plugs to match destination requirements.

Weight: Net, 7.9 kg (17 lb, 6 oz).

Dimensions:[3] 266 mm wide x 178 mm high x 305 mm deep (10½" x 7" x 12").

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[1] AM is possible above +3 dBm as long as the combination of the AM depth plus carrier output level does not exceed +9 dBm.

[2] 400 and 1000 Hz modulation rates.

[3] Dimensions are for general information only. If dimensions are required for building special enclosures, contact your HP office.

Table 1-2. Recommended Test Equipment (1 of 3)

Instrument Type	Critical Specifications	Suggested Model	Use*
20 dB Amplifier	Range: 10—520 MHz Gain: 20 to 25 dB Flatness over Range: ±2 dB Impedance: 50Ω Noise Figure: <5 dB	HP 8447A	P
20 dB Amplifier	Range: 400—1200 MHz Gain: >20 dB Flatness: ±2 dB Impedance: 50Ω Noise Figure: <5 dB to 1 GHz	HP 8447B	P
40 dB Amplifier	Range: 5 Hz to 50 kHz Gain: 20 and 40 dB ±1 dB Input Impedance: >5kΩ Output Impedance: 50Ω Noise: <25 μVrms referred to input Output: >1 Vrms into 50Ω	HP 465A	P
One-Inch Loop Antenna	2-turn, 25 mm (1 inch) dia., 25 mm (1 inch) from end. To ensure measurement accuracy, no substitution is possible. Fabrication depends upon machining and assembling to close tolerances.	HP 08640-60501	P
10 dB Step Attenuator	Attenuation: 0–50 dB in 10 dB steps Range: dc—520 MHz Accuracy: ±1.5 dB to 50 dB below 520 MHz	HP 355D	P, A
10 dB Attenuator (req'd for Opt. 003 only)	Accuracy: ±0.5 dB to 520 MHz	HP 8491A Opt. 010	A
Digital Multimeter	Voltage Range: 1V or less Display: 4½ digits or more DC Accuracy: ±(0.03% or reading +0.02% of range) AC Accuracy: ±(0.25% of reading +0.05% of range) Ohms Range: to 1 MΩ	HP 34702A/34740A	P, A, T
Distortion Analyzer	Range: 20 Hz to 10 kHz Distortion Range: <0.1% Minimum Input: <300 mVrms	HP 331A	P, A
Frequency Meter Filter Kit	Ranges: 100 kHz to 10 MHz Linear Analog Output: 1V for full scale Output Low-pass Filters for HP 5210A Frequency Meter (10 kHz and 100 kHz Butterworth filters)	HP 5210A HP 10531A	P, A

*P = Performance; A = Adjustments; T = Troubleshooting

Table 1-2. Recommended Test Equipment (2 of 3)

Instrument Type	Critical Specifications	Suggested Model	Use*
4 MHz Low-pass Filter	4 MHz low-pass (3 pole) Impedance: 50Ω	CIR-Q-TEL** FLT/21B-4-3/ 50-3A/3B	P, A
15 kHz Low-pass Filter	15 kHz low-pass (7 pole) Impedance: 50Ω Ripple: <±0.2 dB	CIR-Q-TEL** FLT/21B-15K- 7/50-3A/3B	P
Frequency Counter	Range: to 520 MHz Input Sensitivity: <100 mV Inputs: 50Ω and high impedance (1 MΩ) Accuracy: ±0.1%	HP 5383A	P, A, T
Frequency Counter (If available, substitute for HP 5383A)	Range: to 520 MHz Input Sensitivity: <100 mV Inputs: 50Ω and high impedance (1 MΩ) Accuracy: ±0.1% Short Term Stability: $< 2 \times 10^{-9}$ rms for 1 s. Must be able to display frequency difference measured sequentially between two channels and to produce an external gate pulse at start of each count.	HP 5345A/5354A (HP 5345A/5353A will also serve in this application)	A
Mixer	Double Balanced Range: 10—520 MHz	HP 10514A	P, A
Oscilloscope	50 MHz Real Time Sensitivity: 5 mV/division	HP 1820C/1801A/ 182C	P, T
Power Meter Power Sensor	Input Level: −20 to +20 dBm Accuracy: ±1% of reading Range: 10—530 MHz SWR: <1.2:1	HP 435A HP 8481A	P, A,T
RMS Voltmeter	Range: 10 Hz to 50 kHz Reading: True rms (ac only) Voltage Range: 1 mV to 10V full scale Accuracy: 1% of full scale 50 Hz to 50 kHz Scale: Voltage and dB	HP 3400A	P
Signal Generator	Range: 10—520 MHz Output: > +7 dBm into 50Ω Drift: <20ppm/10 min Residual FM: <50 Hz rms in 20 Hz to 15 kHz post-detection noise bandwidth; <30 Hz rms in 0.3—3 kHz post detection noise bandwidth at 270—520 MHz.	HP 8640A	P, A

*P = Performance; A = Adjustments; T = Troubleshooting
**CIR-Q-TEL INC./10504 Wheatley/Kensington, MD 20795/Phone 301-946-1800.

Table 1-2. Recommended Test Equipment (3 of 3)

Instrument Type	Critical Specifications	Suggested Model	Use*
Spectrum Analyzer	Range: 10—1200 MHz Input Impedance: 50Ω Amplitude Calibration: Display Accuracy: ±0.25 dB/dB but not more than 1.5 dB over 70 dB dynamic range Flatness: ±1 dB IF Gain Step Accuracy: ±0.2 dB Vertical Reference Scale: 10 dB/division log, 2 dB/division (or less) log, and linear display calibration. Average Noise Level: <—102 dBm with 10 kHz IF bandwidth Spurious Resposnes: >60 dB down for inputs of —40 dBm or less Maximum Bandwidth: ⩾300 kHz Span Width: 0—1 GHz Compatible with Tracking Generator	HP 8558B/182C Opt. 807	P, A
Test Oscillator	Range: 10 Hz to 50 kHz Output Impedance: 600Ω and 50Ω Distortion: >40 dB down Output Level: >1 Vrms	HP 651B	P, A
Tracking Generator (required for Opt. 003 only)	Output: to 0 dBm (50Ω) Flatness: ±0.5 dB Compatible with Spectrum Analyzer HP 8558B/182C	HP 8444A Opt. 058	A
SWR Bridge (required for Opt. 003 only)	Range: 10—520 MHz Directivity: >40 dB Connectors: Type N	Wiltron Model** 60N50	A
FM Deviation Adjustment Board	Produces ±0.949V square wave triggered by an external counter. Resistance substitution circuit. No substitution is possible.	HP 08654-60084	A
50Ω Load (2 req.)		HP 11593A	P
50Ω Load (required for Opt. 003 only)	SWR <1.05 (dc—520 MHz)	HP 908A	A
Coaxial Short (Male Type N)		HP 11512A	A
Double Shielded Cable (BNC, Male, coaxial 2 required)		HP 08708-6033	P

*P = Performance; A = Adjustments; T = Troubleshooting

**Wiltron Compa[illegible]030 E. Meadow Dr./Palo Alto, CA 94303/TWX 9103731156/Phone 415-494-6666

SECTION II
INSTALLATION

2-1. INTRODUCTION

2-2. This section provides information about incoming inspection, selecting the input line voltage, operating environment, and information applicable to bench and rack mounting.

2-3. INITIAL INSPECTION

2-4. Inspect the shipping container for damage If the shipping container or cushioning material is damaged it should be kept until the contents of the shipment have been checked for completeness and the instrument has been checked mechanically and electrically. The contents of the shipment are as shown in Figure 1-1, and the procedures for checking electrical performance are given in Section IV. If the contents are incomplete, if there is mechanical damage or defects, or if the instrument does not pass the electrical performance test, notify the nearest Hewlett-Packard office. If the shipping container is damaged or the cushioning material shows signs of stress, notify the carrier as well as the Hewlett-Packard office. Keep the shipping materials for the carrier's inspection. The HP office will arrange for repair or replacement without waiting for claim settlements.

2-5. PREPARATION FOR USE

2-6. Power Requirements

2-7. The 8654B Signal Generator requires a power source of 100, 120, 220 or 240 Vac +5% −10%, 48 to 440 Hz single phase. Power consumption is less than 25 VA.

2-8. Line Voltage Selection

2-9. Figure 2-1 provides instructions for line voltage and fuse selection. The line voltage for which the instrument is set is visible in the module window.

CAUTION

To prevent damage to the instrument, make the line voltage and fuse selection before connecting the power cable.

NOTE

The correct fuse rating for the line voltage is shown on the rear panel. Fuse part numbers are given in the Replaceable Parts Table in Section VI. (The reference designator is F1.)

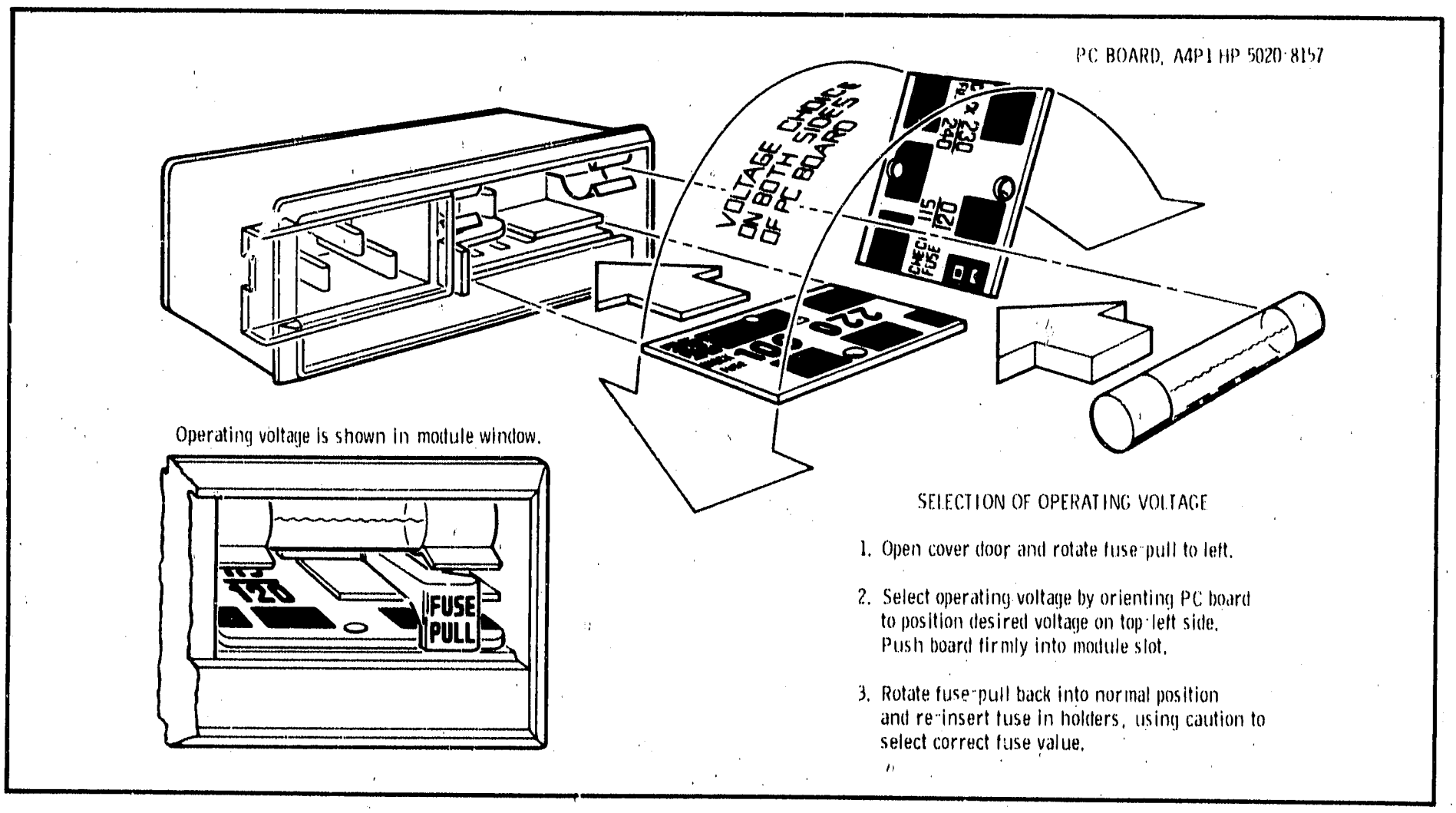


Figure 2-1. Line Voltage Selection

2-10. Power Cable

2-11. In accordance with international safety standards, this instrument is equipped with a three-wire power cable. When connected to an appropriate ac power receptacle, this cable grounds the instrument cabinet. The type of power cable plug shipped with each instrument depends on the country of destination. Refer to Figure 2-2 for the part numbers of the power cable plugs available.

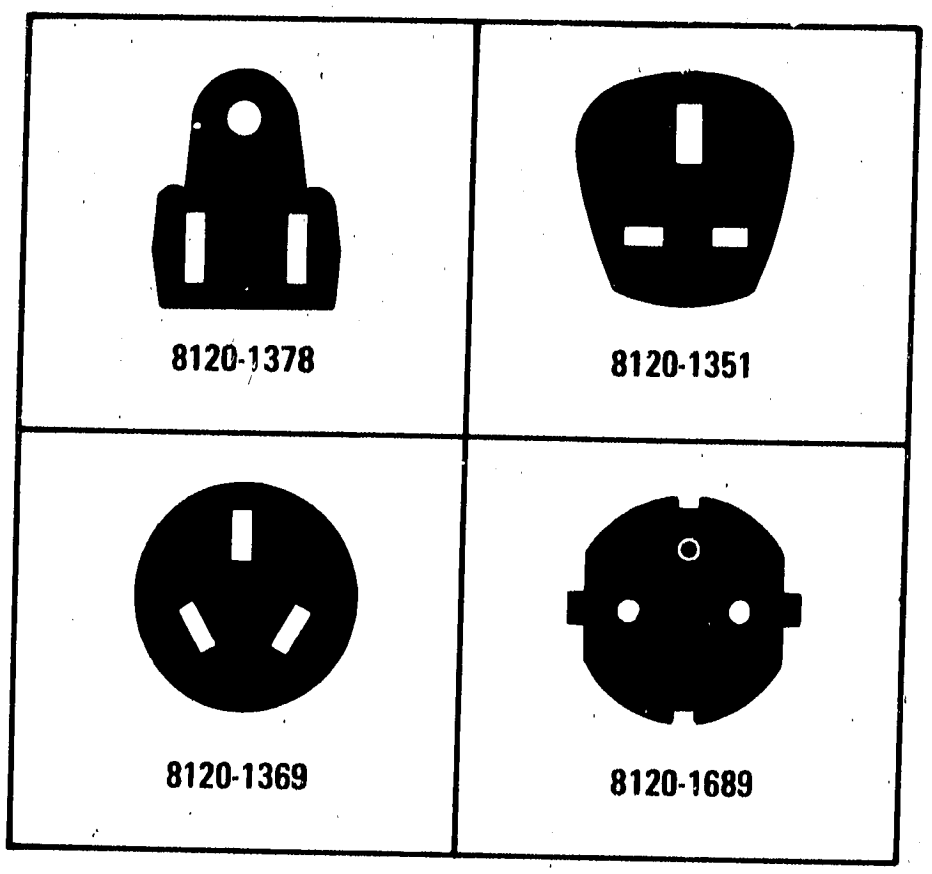


Figure 2-2. Power Cables Available

WARNING

The protection provided by grounding the instrument may be lost if any power cable other than the three-pronged type supplied is used to couple the ac line voltage to the instrument.

2-12. Operating Environment

2-13. The operating environment should be within the following limitations:

Temperature . . . . . 0 to +55°C
Humidity . . . . . <95% relative
Altitude . . . . . <4600 metres (15 000 feet)

2-14. Bench Operation

2-15. The instrument cabinet has plastic feet and foldaway tilt stands for convenience in bench operation. The plastic feet are shaped to ensure self-aligning of the instruments when stacked. The tilt stands raise the front of the instrument for easier viewing of the control panel.

2-16. Rack Mounting

2-17. Rack Adapter Frames. Hewlett-Packard adapter frames are an economical means of rack mounting instruments that are narrower than full rack width. A set of spacer clamps, supplied with each adapter frame, permits instruments of different dimensions to be combined and rack mounted as a unit. Accessory blanks are available for filling unused spaces.

2-18. Combining Cases. Model 1051A and 1052A Combining Cases are metal enclosures that allow combinations of third- or half-rack width instruments to be assembled for use on a workbench or for mounting in a rack of 482.5 mm (standard 19-inch) spacing. Each case includes a set of partitions for positioning and retaining instruments, and a rack mounting kit. No tools are required for installing the partitions. For bench use the cases have the same convenience features as full rack width instruments (i.e., foldaway tilt stands and specially-designed feet for easier instrument stacking). Accessories available for the combining cases include fan kits, blank filler panels, and snap-on full width control panel covers.

2-19. STORAGE AND SHIPMENT

2-20. Environment

2-21. The instrument should be stored in a clean, dry environment. The following environmental limitations apply to both storage and shipment.

Temperature . . . . . −40 to +75°C
Humidity . . . . . <95% relative
Altitude . . . . . <7600 metres (25 000 feet)

2-22. Packaging

2-23. Original Packaging. Containers and materials identical to those used in factory packaging are available through Hewlett-Packard offices. If the instrument is being returned to Hewlett-Packard for servicing, attach a tag indicating the type of service required, return address, model number, and full serial number. Also, mark the container FRAGILE to assure careful handling. In any correspondence, refer to the instrument by model number and full serial number.

2-24. Other Packaging. The following general instructions should be used for re-packaging with commercially available materials:

a. Wrap the instrument in heavy paper or plastic. (If shipping to a Hewlett-Packard office or service center, attach a tag indicating the type of service required, return address, model number, and full serial number.)

b. Use a strong shipping container. A double-wall carton made of 2.4 MPa (350 psi) test material is adequate.

c. Use enough shock-absorbing material (75-100 mm) around all sides of the instrument to provide a firm cushion and prevent movement inside the container. Protect the control panel with cardboard.

d. Seal the shipping container securely.

e. Mark the shipping container FRAGILE to assure careful handling.

OPERATION

SECTION III
OPERATION

3-1. INTRODUCTION

3-2. This section provides complete operating instructions for the HP 8654B Signal Generator. The instructions consist of panel features, operator's checks, operating instructions, and operator's maintenance.

WARNINGS

Before switching on the instrument, the protective earth terminals of the instrument must be connected to the protective conductor of the (mains) power cord. The mains plug shall only be inserted in a socket outlet provided with a protective earth contact. The protective action must not be negated by the use of an extension cord (power cable) without a protective conductor (grounding). Grounding one conductor of a two conductor outlet is not sufficient protection.

Ensure that all devices connected to this instrument are connected to the protective (earth) ground.

Make sure that only fuses with the required rated current and of the specified type (normal blow, time delay, etc.) are used for replacement. The use of repaired fuses and the short-circuiting of fuse holders must be avoided.

CAUTION

Before switching on this instrument, make sure it is set to the proper line voltage.

3-3. PANEL FEATURES

3-4. Front and rear panel features of the 8654B Signal Generator are described in Figures 3-2 and 3-3. These figures contain a detailed description of the Signal Generator controls, indicators, and connectors.

3-5. OPERATOR'S CHECKS

3-6. Upon receipt of the instrument, or to check the Signal Generator for an indication of normal operation, perform the operational procedures listed in Figure 3-4. These procedures are designed to familiarize the operator with the Signal Generator and permit a determination of operating capabilities.

3-7. OPERATING INSTRUCTIONS

3-8. General operating instructions are contained in Figure 3-5. The instructions will familiarize the operator with basic operating functions of the Signal Generator.

3-9. Auxiliary Output

3-10. The isolation of the AUX RF OUT from the front panel RF OUTPUT is typically 30 dB. Any signal that is coupled into the AUX RF OUT jack may be transmitted to the front panel output. An example of this is an electronic counter used to monitor the RF output frequency. Subharmonic signals at the counter input may be coupled into the AUX RF OUT jack and from there to the front panel output where they are transmitted to the load.

3-11. OPERATOR'S MAINTENANCE

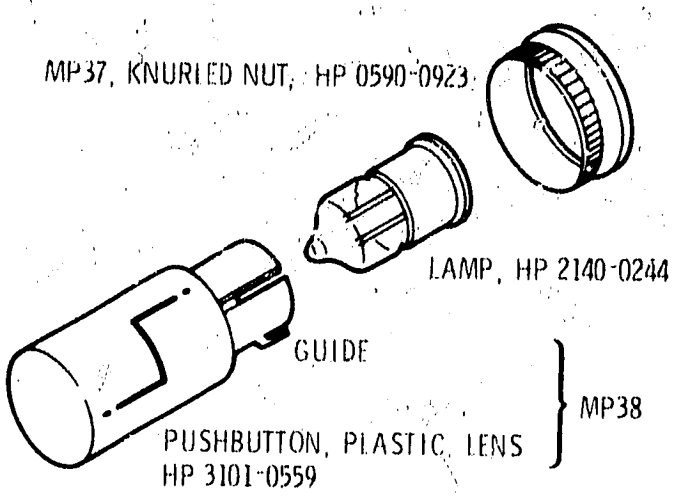
3-12. The maintenance responsibilities of the operator are replacing the primary fuse, the LINE switch lamp and zeroing the meter.

3-13. Fuses. The fuse is located on the rear panel within the power module assembly (see Figure 3-3). Figure 2-1, steps 1 and 3, explain how to remove and install the fuse. Proper fuse ratings for selected line voltages are given on the rear panel. Fuse part numbers may be found in the Replaceable Parts Table in Section VI. Reference designator is F1.

3-14. Line Switch Lamp Replacement. The lamp is contained in the white plastic lens which doubles for the pushbutton on the LINE switch. When the instrument is ON, the lamp should be illuminated.

3-15. Figure 3-1 shows the method of removing and installing the lamp. A replacement lamp, DS1, may be ordered under HP Part Number 2140-0244.

3-16. Meter Zeroing. With the power off the meter's pointer should be positioned directly over zero. If the pointer is not at zero, insert a screwdriver into the adjustment screw, (beneath meter), and align the pointer with zero on the meter scale. This adjustment should only be made when necessary. If a large adjustment is required, the meter calibration should be checked.

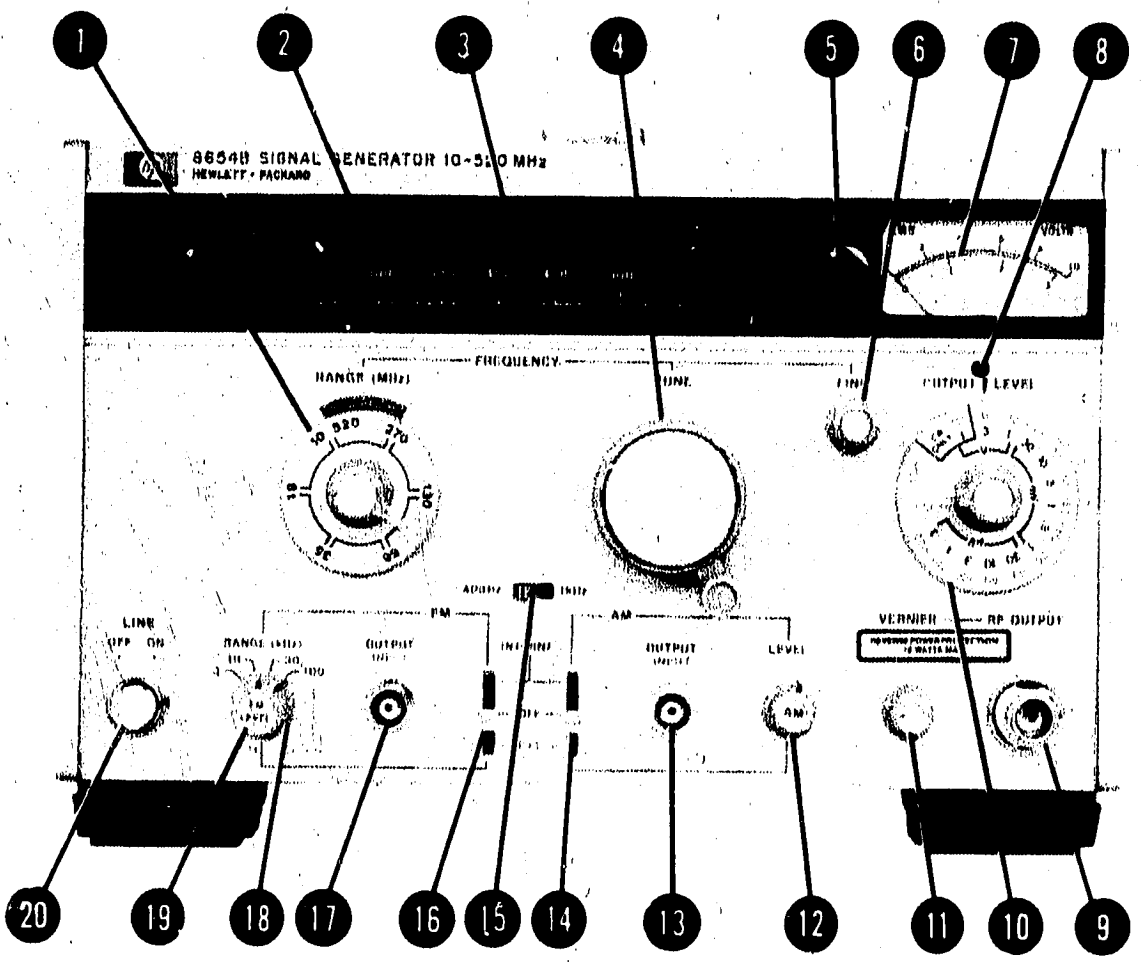


POWER LAMP REPLACEMENT

1. Remove lens by pulling straight out.
2. Replace lamp.
3. To replace lens, align guide with notch in receptacle. Push straight in.

Figure 3-1. Lamp Replacement

FRONT PANEL FEATURES



1 **FREQUENCY RANGE (MHz).** Selects the frequency range as indicated on the control skirt.

2 **Frequency Scale.** Shows the range of frequencies selected by the FREQUENCY RANGE (MHz) control.

3 **Cursor.** Indicates the output frequency; controlled by FREQUENCY TUNE control.

4 **FREQUENCY TUNE Control.** Tunes to the desired output frequency within the selected range.

5 **METER Switch.** Selects meter function.
FM: peak frequency deviation.
AM: percent AM.
LEVEL: output level.

6 **FREQUENCY FINE TUNE Control.** Provides fine adjustment of output frequency.

7 **Meter.** Function controlled by METER switch.
FM (0—3 or 0—10 scale): read FM peak frequency deviation directly from meter within the range indicated by FM RANGE (kHz) knob.
AM (0—10 scale): read value of percent AM within 0 and 100% directly from meter.
LEVEL (dBm 50Ω scale): determine output level (dBm) by adding values indicated on OUTPUT LEVEL knob and meter's scale.
LEVEL (0—3 or 0—10 scale): read output level (volts) directly from meter on the scale indicated on OUTPUT LEVEL knob. OUTPUT LEVEL knob indicates output level for full-scale meter deflection.

8 **Mechanical Zeroing Adjustment.** Screwdriver adjustment used to align meter indicator on zero with power removed from the instrument (see procedure in Section III).

9 **RF OUTPUT Connector.** RF output through Type N female connector. For standard instruments, output level range is +10 dBm to −130 dBm (0.7 Vrms to 0.07 μVrms) into a 50Ω load. For Option 003, output level range is +8 dBm to −130 dBm (0.56 Vrms to 0.07 μVrms into a 50Ω load. AM is restricted above +3 dBm output.

CAUTION

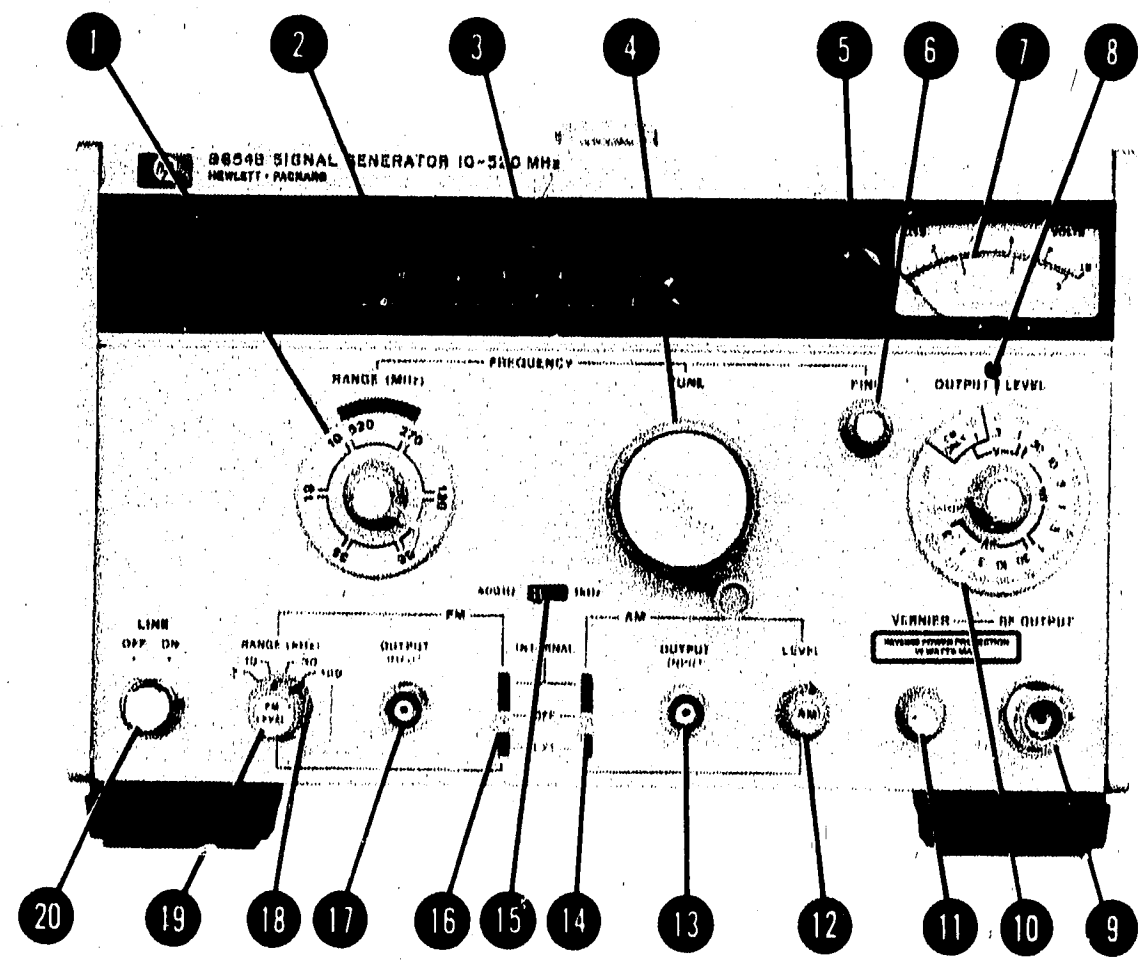
If Option 003 is not installed, application of >+24 dBm (250 mW) into the generator's output is likely to cause damage to the generator. Do not apply reverse power.

NOTE

With Option 003 installed, the generator's output circuitry is protected against reverse power applications up to 25 watts (see label).

Figure 3-2. Front Panel Controls, Connectors, and Indicators (1 of 3)

FRONT PANEL FEATURES



10 **OUTPUT LEVEL Switch.** Selects output range as shown on knob skirt, +10 to −120 dBm (1V to 0.3 μV).

11 **Output Level VERNIER.** Fine adjusts RF output level continuously within a 13 dB range as indicated by the meter.

12 **AM LEVEL Control.** Varies percent AM of RF signal (internal or external AM mode).

13 **AM OUTPUT/INPUT Connector.** Provides output for internal AM signal or input for external AM signals.

AM INTERNAL mode: open-circuit output level ~5 Vrms, output impedance 10 kΩ.

AM EXT (external) mode: input impedance ~600Ω dc coupled. With AM LEVEL set fully cw, 1V peak input produces 100% AM and full-scale meter deflection (0—10 scale).

CAUTION

Applied voltages greater than 10V peak (ac + dc) can damage the AM circuitry.

14 **AM Source Switch.** Selects amplitude modulation source: INTERNAL, EXT (external), or OFF.

NOTE

A mechanical interlock prevents simultaneous internal AM and FM. However, simultaneous AM and FM is possible if at least one source is external.

15 **400 Hz/1 kHz Switch.** Selects 400 Hz or 1 kHz internal modulation signal.

16 **FM Source Switch.** Selects frequency modulation source: INTERNAL, EXT (external), or OFF.

NOTE

A mechanical interlock prevents simultaneous internal AM and FM. However, simultaneous AM and FM is possible, if at least one source is external.

17 **FM OUTPUT/INPUT Connector.** Provides output for internal FM signal or input for external FM signals.

FM INTERNAL mode: open-circuit output level ~5 Vrms, output impedance ~10 kΩ.

FM EXT (external) mode: input impedance ~600Ω, dc coupled. With FM LEVEL set fully cw, 1V peak produces full-scale meter deflection and the maximum peak frequency deviation determined by FM RANGE (kHz). See Table below.

Figure 3-2. Front Panel Controls, Connectors, and Indicators (2 of 3)

FRONT PANEL FEATURES

FM RANGE (kHz)	Meter Scale	Full-Scale Deviation (kHz)
3	0–3	3.16
10	0–10	10
30	0–3	31.6
100	0–10	100

CAUTION

Applied voltages greater than 10 Vpk (ac + dc) can damage the FM circuitry.

18 **FM Range (kHz) Switch.** Selects one of four peak frequency deviaton ranges: 0–3 kHz, 0–10 kHz, 0–30 kHz, or 0–100 kHz. Peak frequency deviation is set with FM LEVEL control.

NOTES

FM is not specified on the 100 kHz range for RF signals less than 80 MHz.

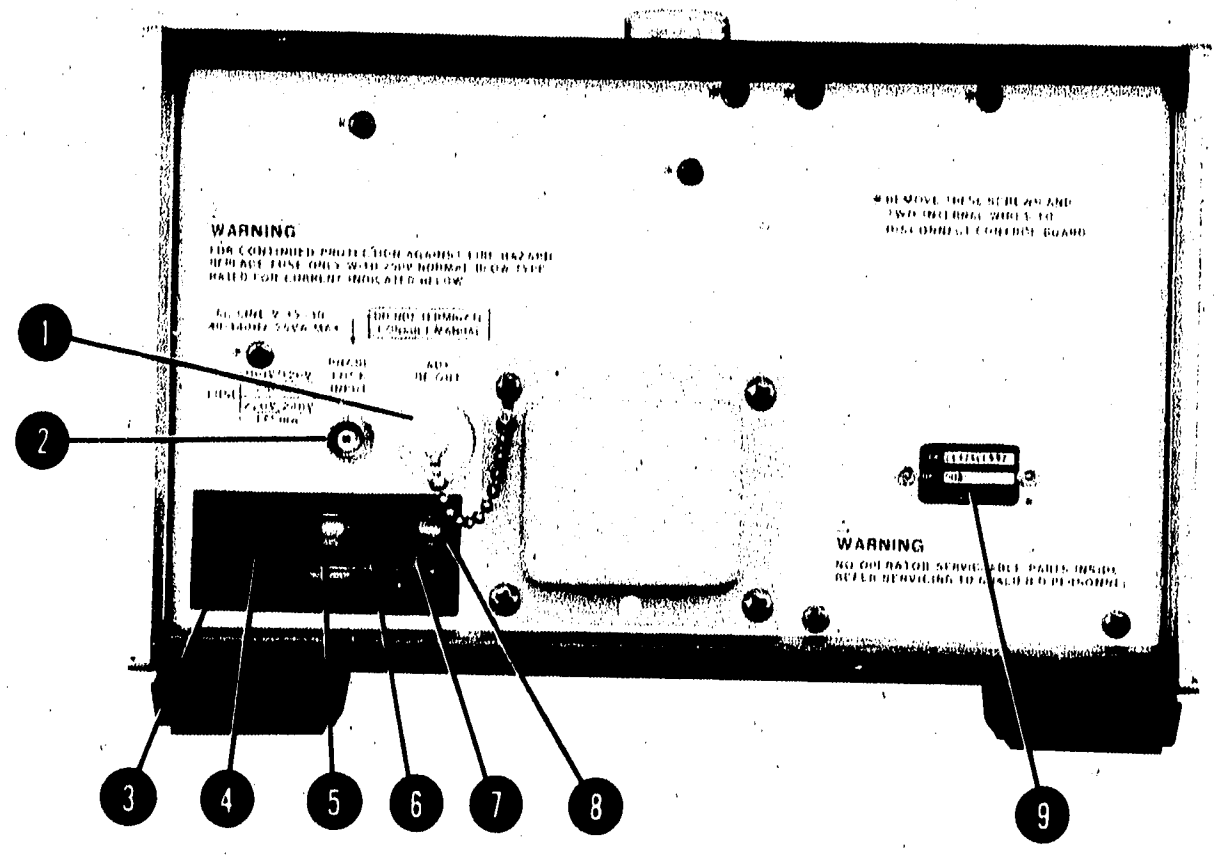
For best FM performance, use lowest range which includes the peak deviation desired.

19 **FM LEVEL Control.** Varies peak frequency deviation (internal or external FM mode). Maximum peak deviation determined by FM RANGE (kHz) setting.

20 **LINE OFF/ON Switch.** Controls primary power. Illuminated when switch is set to "ON".

Figure 3-2. Front Panel Controls, Connectors, and Indicators (3 of 3)

REAR PANEL FEATURES



1 AUX RF OUT Connector. Provides RF signal, 10—520 MHz at > —7 dBm (fixed level) output into a 50Ω load. Signal is unleveled and does not contain amplitude modulation but does contain calibrated frequency modulation.

NOTE

The isolation of the AUX RF OUT from the front panel RF OUTPUT is typically 30 dB. Any signal that is coupled into the AUX RF OUT may be transmitted to the generator's output. An example of this is an electronic counter used to monitor the RF output frequency. Subharmonic signals at the counter input are coupled into the AUX RF OUT and from there to the front panel output where they are transmitted to the load.

2 PHASE LOCK INPUT Connector. Couples output of an external phase lock synchronizer such as HP 8655A to the electronic fine tuning circuit in the Signal Generator. Stability (drift) of generator is then determined primarily by stability of reference oscillator in the synchronizer. (The synchronizer's input can be connected to AUX RF OUT.)

NOTES

Use of a phase lock synchronizer will likely cause some degradation of FM sensitivity accuracy and indicated FM accuracy.

Do not use HP Model 8708A synchronizer or any low-impedance source to drive the PHASE LOCK INPUT port.

3 Line Module Assembly. Permits operation from 100, 120, 220 or 240 Vac. The number visible in window indicates nominal line voltage to which instrument must be connected (see Figure 2-1). Center conductor is safety earth ground.

WARNING

Any interruption of the protective (grounding) conductor inside or outside the instrument or disconnection of the protective earth terminal is likely to make the instrument dangerous. Intentional interruption is prohibited. (See Section II.)

4 Receptacle. To couple Line Power Cable to instrument.

Figure 3-3. Rear Panel Features (1 of 2)

REAR PANEL FEATURES

5 **Line Voltage Selection Card.** Matches transformer primary to available line voltage.

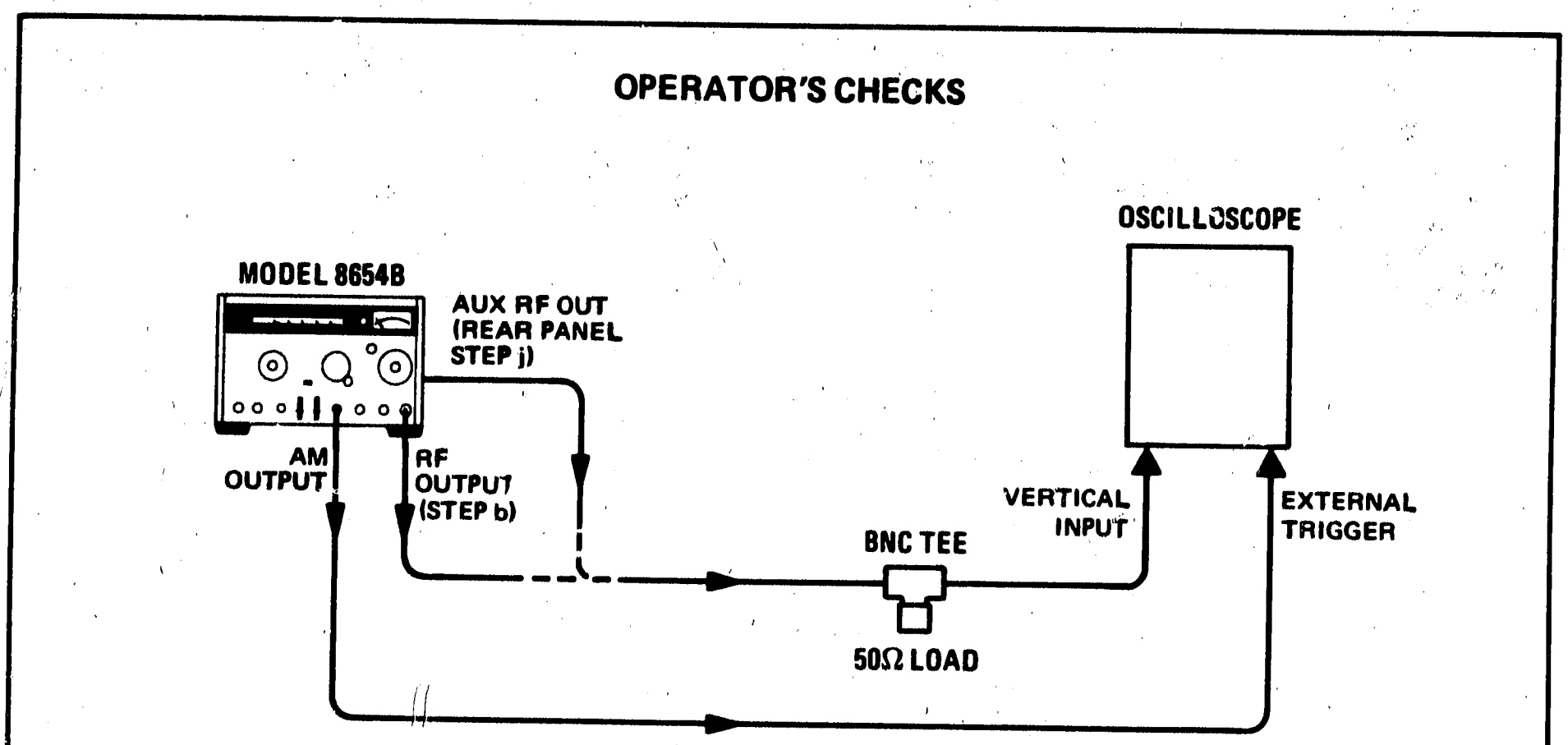
6 **Fuse.** 250 mA (250V, Normal Blow for 100/120 Vac. 175 mA (250V, Normal Blow, for 220/240 Vac.

7 **FUSE PULL Handle.** Mechanical interlock to guarantee fuse has been removed before Line Voltage Selection Card can be removed.

8 **Window.** Safety interlock ensures fuse cannot be removed while power cable is coupled to the 8654B.

9 **Serial Number Plate.** First four numbers and letter constitute the prefix that denotes the instrument configuration. The last five digits form the suffix that is unique to each instrument. The Serial Number plate also indicates any options supplied with instrument.

Figure 3-3. Rear Panel Features (2 of 2)



INITIAL SETTINGS

a. Verify that the power transformer primary is matched to the line voltage and that the correct fuse is installed within the rear panel Line Module Assembly. See Line Voltage Selection in Section II.

b. Insert the power cable to the power outlet and Line Module receptacles. Set the LINE switch to ON; the lamp within the switch lens should be illuminated.

c. Set the generator's controls as follows:

METER	LEVEL
FREQUENCY RANGE (MHz)	10–19 MHz
FREQUENCY TUNE	10.0 MHz
OUTPUT LEVEL Switch	0.1 V
Output Level VERNIER	Full scale meter reading (0.1 Vrms)
AM	OFF
FM	OFF
400 Hz/1 kHz	1 kHz

RF OUTPUT

d. Connect the equipment as shown above and verify that the 10.0 MHz signal has an output level of ~0.3 Vp-p.

NOTES

The oscilloscope must have a bandwidth of >10 MHz to perform these checks.

If the oscilloscope has a 50Ω input impedance, the BNC tee and 50Ω load should be omitted.

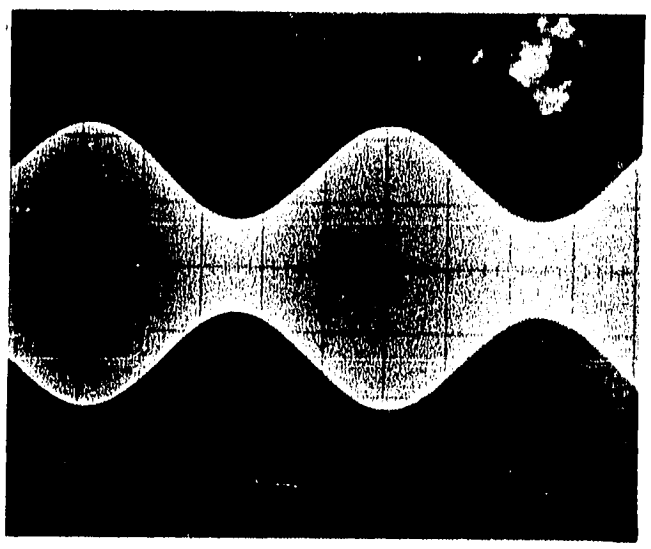
Figure 3-4. Operator's Checks (1 of 2)

OPERATOR'S CHECKS

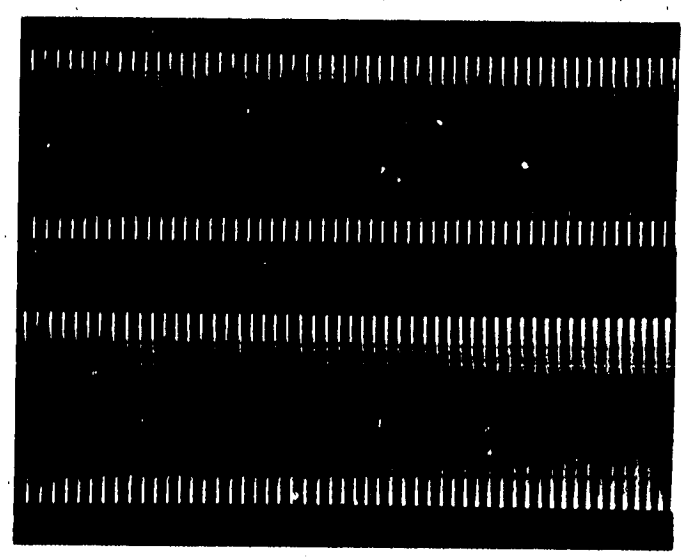
AMPLITUDE MODULATION

e. Set the 8654B AM Source to INTERNAL and set the oscilloscope time base trigger to external.

f. Set METER Switch to AM and rotate AM LEVEL control cw until the meter indicates 50% modulation depth. Verify that the AM envelope display shows a peak-to-valley voltage difference of about 0.15V with a period of 1.0 ms.



Typical AM Envelope



Typical FM Display with CW Display for Comparison

g. Set the 400 Hz/1 kHz switch to 400 Hz; verify the AM envelope period is 2.5 ms.

FREQUENCY MODULATION

h. Set AM Source switch to OFF and set FM Source switch to INTERNAL. Set the oscilloscope time base trigger to internal.

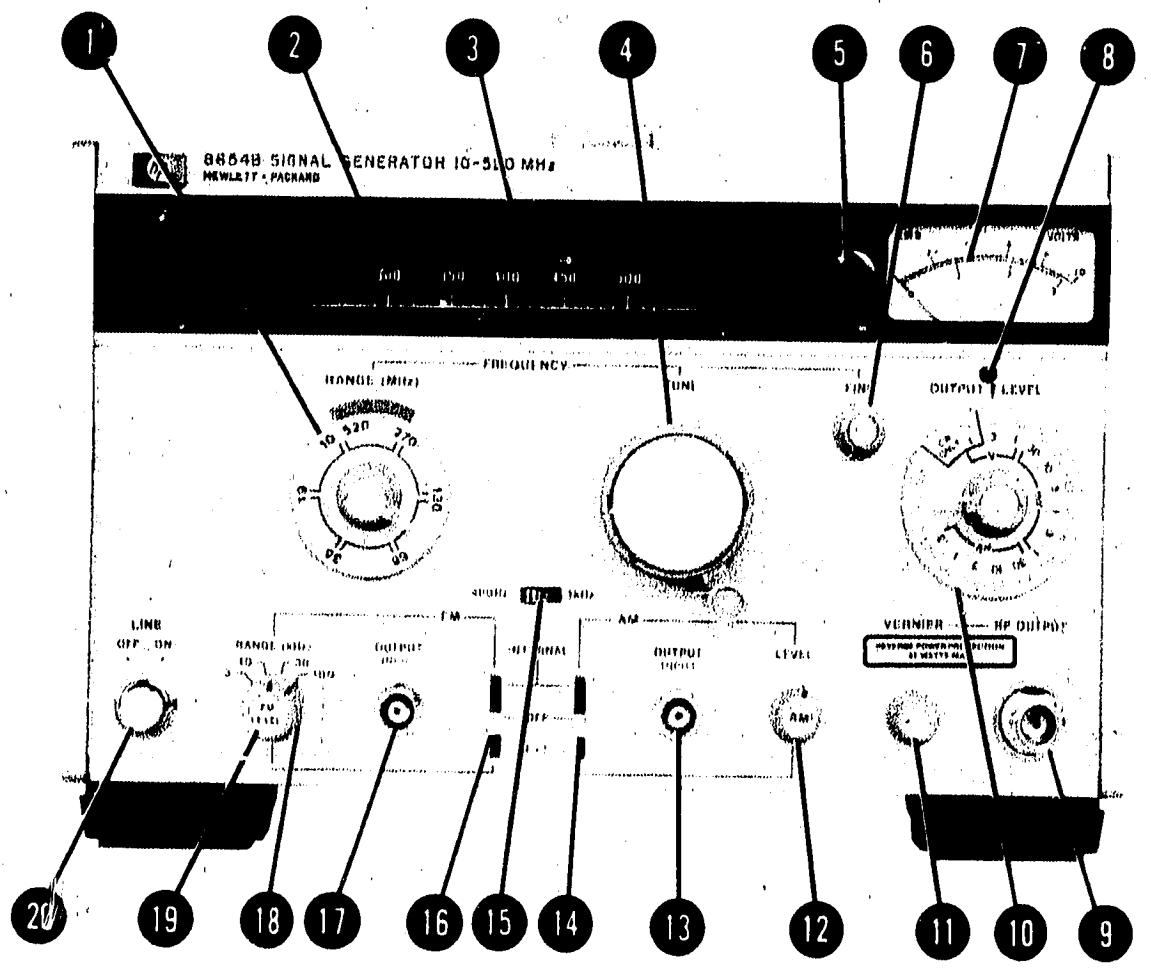
i. Set METER switch to FM and FM RANGE (kHz) to 30 kHz. Adjust FM LEVEL so that the meter indicates 30 kHz peak frequency deviation. Verify that the oscilloscope shows the typical FM display.

AUX RF OUT

j. Connect the generator's AUX RF OUT (rear panel) to the oscilloscope's vertical input and verify that a 10.0 MHz signal of $>$ 0.3 Vp-p is displayed.

Figure 3-4. Operator's Checks (2 of 2)

OPER TING INSTRUCTIONS



TURN ON

a. Verify that the power transformer primary is matched to the line voltage. See Line Voltage Selection in Section II.

b. Check the fuse, which is contained in the Line Module Assembly, for the correct rating. The voltage and current ratings are given in a table on the rear panel. If necessary, change the fuse.

c. Insert the power cable to the power outlet and the Line Module receptacles. Press the LINE switch (20) and release. The switch should remain in, the lamp within the plastic lens should be illuminated, and the cursor on the curved portion of the button should indicate ON.

NOTE

To ensure the 8654B will perform to the standards set forth in the published specifications, let the instrument warm up for two hours before using.

FREQUENCY SELECTION

d. Set FREQUENCY RANGE (MHz) (1) to the range which includes the desired carrier frequency.

e. Tune to the carrier frequency with the FREQUENCY TUNE control (4); FREQUENCY FINE TUNE (6) provides greater tuning resolution. The Cursor (3) indicates the carrier frequency.

Figure 3-5. Operating Instructions (1 of 5)

OPERATING INSTRUCTIONS

OUTPUT LEVEL SELECTION

f. Set METER switch (5) to LEVEL. Set the OUTPUT LEVEL control (10) and VERNIER (11) to the desired output level. For optimum AM performance and level meter accuracy, the VERNIER control should be set for a meter indication of −7 to +3 on the dBm scale (> 1/3 full scale). Amplitude modulation is restricted above +3 dBm.

g. Vary the VERNIER control (11) until the level indicated on the OUTPUT LEVEL range control (10) added to the Meter indication (1) equals the desired level. (For voltage, keep in mind that meter full-scale is equivalent to the voltage shown on the OUTPUT LEVEL range control skirt (10).)

AM – INTERNAL

h. Set AM Source (14) to INTERNAL.

i. Select 400 Hz or 1 kHz modulation rate with the 400 Hz/1 kHz frequency switch (15).

j. Set METER switch (5) to AM and vary AM LEVEL control (12) until the Meter (1) indicates the desired modulation depth. Use top scale (10 = 100%).

AM – EXTERNAL

k. Set METER switch (5) to AM, and AM Source (14) to EXT. Apply signal to the AM OUTPUT/INPUT connector (13) (600 ohm load impedance). The Signal Generator requires 1 Vpk (0.707 Vrms) for 100% modulation (AM is specified to 90%). Set percent AM using AM LEVEL (12) and Meter (7).

CAUTION

Damage to the generator's internal circuitry may occur if inputs greater than 10 Vpk (ac + dc) are coupled into the AM OUTPUT/INPUT connector.

NOTES

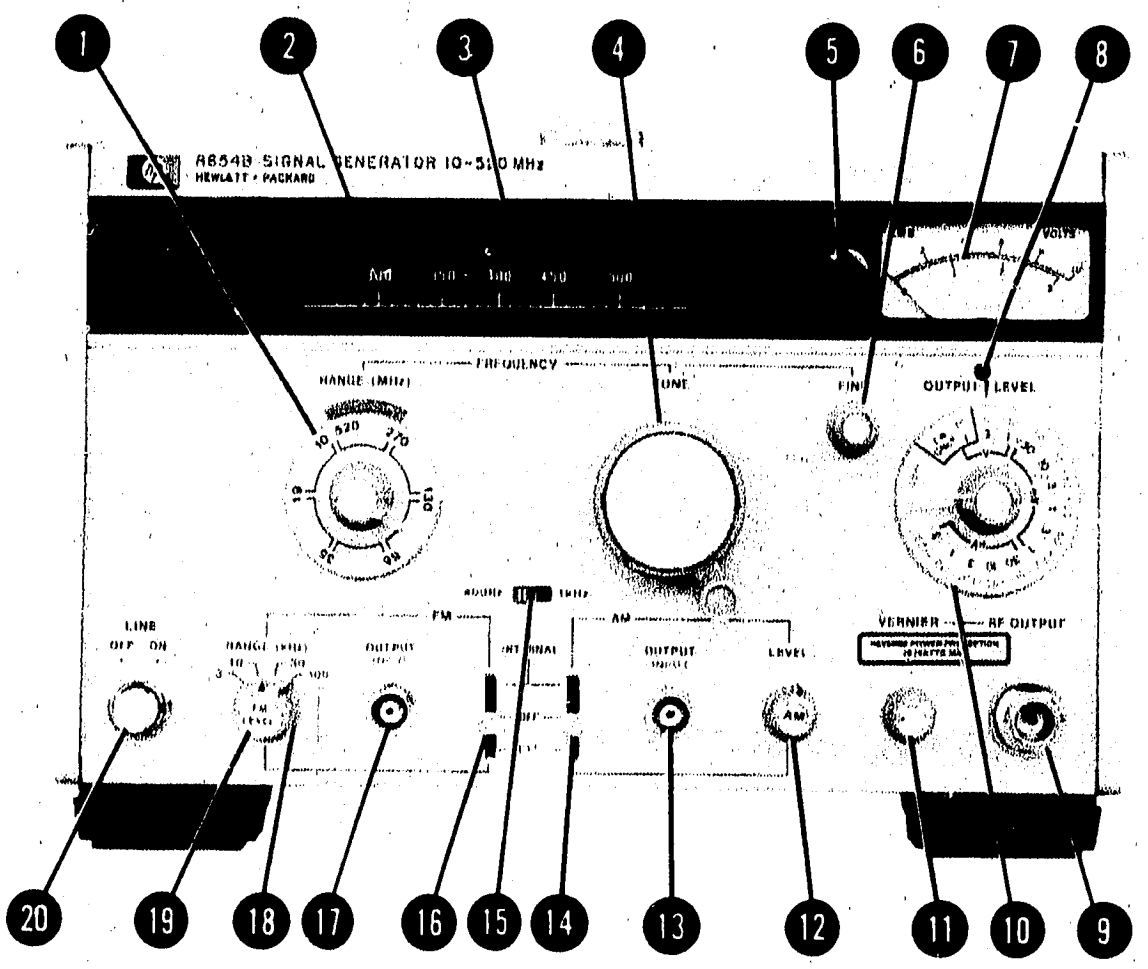
For more precise setting of %AM using an external source, set AM LEVEL (12) fully cw. Monitor the voltage at AM INPUT with an external voltmeter. With AM LEVEL set fully cw, 1 Vpk (0.707 Vrms) produces 100% AM (AM is specified to 90%).

Amplitude modulation is not recommended when the OUTPUT LEVEL control is set to +10 dBm. If AM is necessary, monitor the RF output with an oscilloscope to verify that the distortion is minimal. Frequency modulation is permissible on the +10 dBm range.

The AM meter responds to the positive peaks of the modulation signal. If the modulation signal waveform is asymmetrical or if it has a dc component, the meter reading will be in error.

Figure 3-5. Operating Instructions (2 of 5)

OPERATING INSTRUCTIONS



FM – INTERNAL

l. Set FM Source (16) to INTERNAL.

m. Select 400 Hz or 1 kHz internal modulating rate with the 400 Hz/1 kHz frequency switch (15).

n. Select desired peak deviation range with FM RANGE (kHz) control (18). Set METER switch (5) to FM and vary FM LEVEL control (19) until the Meter (7) indicates desired deviation.

FM – EXTERNAL

o. Set METER switch (5) to FM, and FM Source (16) to EXT. Set FM RANGE (kHz) (18) to the lowest range that includes the frequency deviation desired. Apply signal to the FM OUTPUT/INPUT connector (17) (600 ohm load impedance). The Signal Generator requires 1 Vpk (0.707 Vrms) for maximum peak frequency deviation on any FM range (see table below). Set peak frequency deviation using FM LEVEL (19) and Meter (7).

CAUTION

Damage to the generator's internal circuitry may occur if inputs greater than 10 Vpk (ac + dc) are coupled into the FM OUTPUT/INPUT connector.

Figure 3-5. Operating Instructions (3 of 5)

OPERATING INSTRUCTIONS

FM – EXTERNAL (Cont'd)

NOTES

For more precise setting of FM peak deviation using an external source, set FM LEVEL (19) fully cw. Monitor the voltage at FM INPUT with an external voltmeter. With FM LEVEL fully cw, 1 Vpk (0.707 Vrms) produces maximum deviation on any FM range (see table below).

FM RANGE (kHz)	Meter Scale	Full-Scale Deviation (kHz)
3	0–3	3.16
10	0–10	10
30	0–3	31.6
100	0–10	100

FM is not specified on the 100 kHz range for RF signals less than 80 MHz.

SIMULTANEOUS AM AND FM

p. Simultaneous AM and FM is possible if at least [illegible] modulation sources is external. Follow the appropriate steps above for internal or external modulation.

PULSE MODULATION

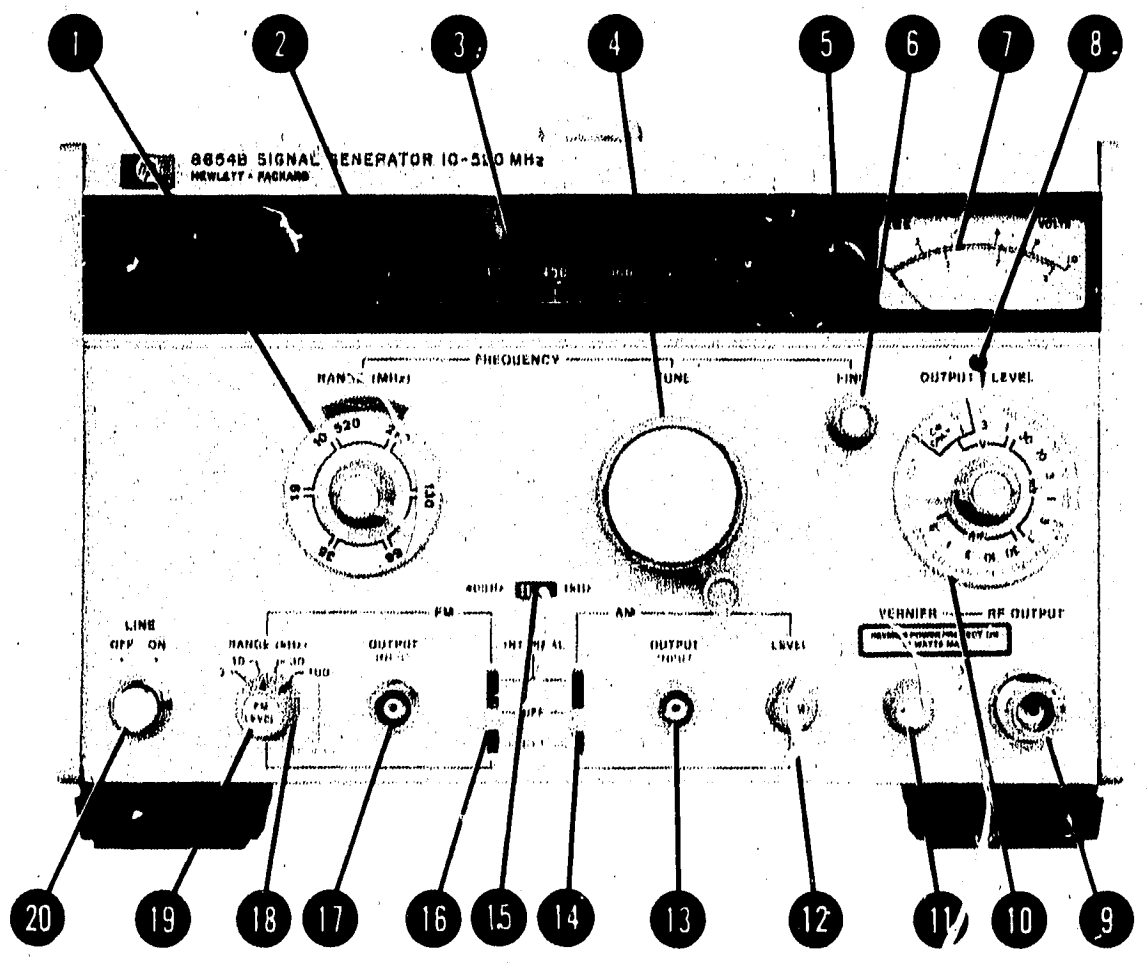
q. Set FREQUENCY RANGE (MHz) and FREQUENCY TUNE controls to the desired frequency, the AM and FM Source controls to OFF, and AM LEVEL fully cw.

r. Set OUTPUT LEVEL and VERNIER controls to the desired output level. (This will be the output level during pulse on-time.)

s. Connect a pulse generator to the AM OUTPUT/INPUT connector.

Figure 3-5. Operating Instructions (4 of 5)

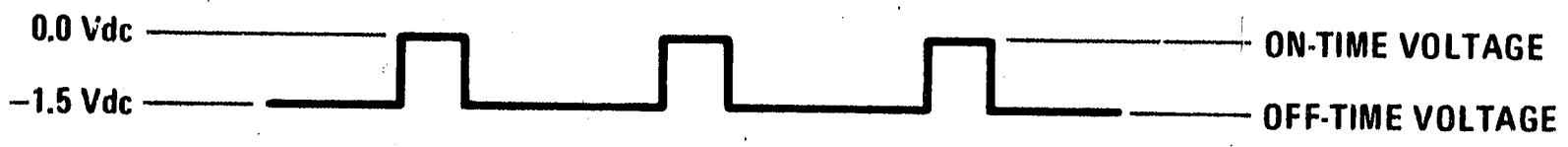
OPERATING INSTRUCTIONS



t. **Set the pulse generator controls to produce a pulse on-time voltage of 0.0 Vdc and an off-time voltage of −1.5 Vdc (see waveform below). Set other pertinent pulse generator controls.**

CAUTION

Damage to the generator's input circuitry may occur if inputs greater than 10 Vpk (ac + dc) are coupled to the AM OUTPUT/INPUT connector.



NOTES

The pulse-on time voltage must be 0.0 Vdc or the output level during the on-time will not be equal to the preset level.

The on-off ratio is typically >40 dB.

u. **Set AM Source to EXT.**

NOTE

Rise time for pulse modulated output is typically 50 µs.

Figure 3-5. Operating Instructions (5 of 5)

'ERFORMANCE

CHECK

SECTION IV
PERFORMANCE TESTS

4-1. INTRODUCTION

4-2. The procedures in this section test the electrical performance of the HP Model 8654B using the specifications of Table 1-1 as the performance standards. All tests can be performed without access to the interior of the instrument. A simpler operational test is included in Section III under Operator's Checks.

4-3. EQUIPMENT REQUIRED

4-4. Equipment required for the performance tests is listed in Table 1-2, Recommended Test Equipment, in Section I. Any equipment that satisfies the critical specifications given in the table may be substituted for the recommended model(s).

4-5. TEST RECORD

4-6. Results of the performance tests may be tabulated on the Test Record at the end of the procedures. The Test Record lists all of the tested specifications and their acceptable limits. Test results recorded at incoming inspection can be used for comparison in periodic maintenance, troubleshooting, and after repairs or adjustments.

4-7. PERFORMANCE TESTS

4-8. The performance tests given in this section are suitable for incoming inspection, troubleshooting, or preventative maintenance. During any performance test, all shields and connecting hardware must be in place. The tests are designed to verify published instrument specifications. Perform the tests in the order given and record the data on the test card and/or in the data spaces provided throughout each procedure.

NOTES

Unless otherwise specified, no warm-up period is required for these tests.

Line voltage must be within +4%, −10% of nominal if the performance tests are to be considered valid.

4-9. The specifications are written as they appear in Table 1-1, Specifications. A description of the test and any special instructions or problem areas are included. Most tests that require test equipment have a setup drawing, and all have a list of the required equipment. The initial steps of each procedure give control settings required for that particular test.

4-10. TEST PROCEDURES

4-11. It is assumed that the person performing the following tests understands how to operate the specified test equipment. Equipment settings, other than those for the Model 8654B are stated in general terms. For example, a test might require that a spectrum analyzer's resolution bandwidth be set to 100 Hz; however, the time per division setting would not be specified and the operator would set that control so that the analyzer operates correctly.

4-12. It is also assumed that the person performing the tests will supply whatever cables, connectors, and adapters are necessary. Table 1-2, Recommended Test Equipment, in Section I lists the requirements for some of these items.

CAUTION

To avoid the possibility of damage to test equipment, read completely through each test before starting it. Make any preliminary control settings necessary for correct test equipment operation.

PERFORMANCE TESTS

4-13. FREQUENCY ACCURACY TEST

SPECIFICATION: **Accuracy:** ±3% after 2-hour warm-up.

DESCRIPTION: The frequency at several points on each range is measured with a counter.

EQUIPMENT: Frequency Counter . . . . . HP 5383A

PROCEDURE:

1. Connect Signal Generator RF OUTPUT to counter's high frequency input after setting controls as follows:

METER	LEVEL
FREQUENCY RANGE (MHz)	270—520 MHz
FREQUENCY TUNE	500 MHz
FINE TUNE	Centered
OUTPUT LEVEL Switch	0 dBm
Output Level VERNIER	Fully cw
AM	OFF
FM	OFF

2. After a 2-hour warm-up, precisely set Signal Generator frequency to each point listed in the following table. Counter should read within ±3% of dial indication.

Generator Frequency		Counter Reading (MHz)
RANGE (MHz)	Dial Indication (MHz)	
270—520	500	485.0 _____ 515.0
	450	437.5 _____ 464.5
	400	388.0 _____ 412.0
	350	339.5 _____ 360.5
	300	291.0 _____ 309.0
130—270	130	126.1 _____ 133.9
	150	145.5 _____ 154.5
	170	164.9 _____ 175.1
	190	184.3 _____ 195.7
	210	203.7 _____ 216.3
	230	223.1 _____ 236.9
	250	242.5 _____ 257.5
	270	261.9 _____ 278.1
66—130	130	126.1 _____ 133.9
	120	116.4 _____ 123.6
	110	106.7 _____ 113.3
	100	97.0 _____ 103.0
	90	87.3 _____ 92.7
	80	77.6 _____ 82.4
	70	67.9 _____ 72.1

PERFORMANCE TESTS

4-13. FREQUENCY ACCURACY TEST (Cont'd)

Generator Frequency		Counter Reading (MHz)
RANGE (MHz)	Dial Indication (MHz)	
35—66	35	34.0 _____ 36.1
	40	38.8 _____ 41.2
	45	43.7 _____ 46.4
	50	48.5 _____ 51.5
	55	53.4 _____ 56.7
	60	58.2 _____ 61.8
	65	63.1 _____ 67.0
19—35	35	33.95 _____ 36.05
	30	29.10 _____ 30.90
	25	24.25 _____ 25.75
	20	19.40 _____ 20.60
10—19	10	9.70 _____ 10.30
	12	11.64 _____ 12.36
	14	13.58 _____ 14.42
	16	15.52 _____ 16.48
	18	17.46 _____ 18.54

4-14. HARMONIC DISTORTION TEST

SPECIFICATION: **Harmonic Distortion** (output power ≤ + 3 dBm): >20 dB below carrier (dBc).
Option 003: >15 dBc.

DESCRIPTION: Harmonics are measured with a spectrum analyzer at a +3 dBm output from the Signal Generator as the frequency is tuned from 10 to 520 MHz.

EQUIPMENT:

Spectrum Analyzer	HP 8558B/182C

PROCEDURE:

1. Connect Signal Generator RF OUTPUT to spectrum analyzer input after setting generator controls as follows:

METER	LEVEL
FREQUENCY RANGE (MHz)	270—520 MHz
FREQUENCY TUNE	520 MHz
OUTPUT LEVEL Switch	0 dBm
Output Level VERNIER	Meter reads +3 dB
AM	OFF
FM	OFF

PERFORMANCE TESTS

4-14. HARMONIC DISTORTION TEST (Cont'd)

2. Set spectrum analyzer resolution bandwidth to 300 kHz or greater, and optimum input level to 0 dBm (40 dB attenuation). Set analyzer frequency span and center frequency controls, and set Signal Generator FREQUENCY RANGE control as listed in the following table. For each FREQUENCY RANGE, tune generator across the range. Record minimum difference of harmonic levels with respect to fundamental. Harmonics should be more than 20 dB down from fundamental (more than 15 dB down for Option 003).

Spectrum Analyzer		Signal Generator	Harmonics (dB down from carrier)	
Frequency Span Per Division (MHz)	Center Frequency (MHz)	FREQUENCY RANGE (MHz)	Standard	Option 003
100	700	270–520	20_____	15 _____
100	600	130–270	20 _____	15 _____
100	500	66–130	20 _____	15 _____
50	250	35–66	20 _____	15 _____
20	100	19–35	20 _____	15 _____
10	50	10–19	20 _____	15 _____

4-15. RESIDUAL AM TEST

SPECIFICATION: **Residual AM** (average rms): >55 dBc in a 50 Hz to 15 kHz post-detection noise bandwidth.

DESCRIPTION: To calibrate the system, the Signal Generator is internally amplitude modulated at at 10% depth. The AM is demodulated with a spectrum analyzer in a zero-frequency span mode. The demodulated AM is amplified and measured with a true rms voltmeter which becomes a reference of 20 dB down from the carrier. The AM is shut off and the amount of residual AM is measured relative to the 20 dB reference. A filter at the voltmeter input defines the measurement bandwidth.

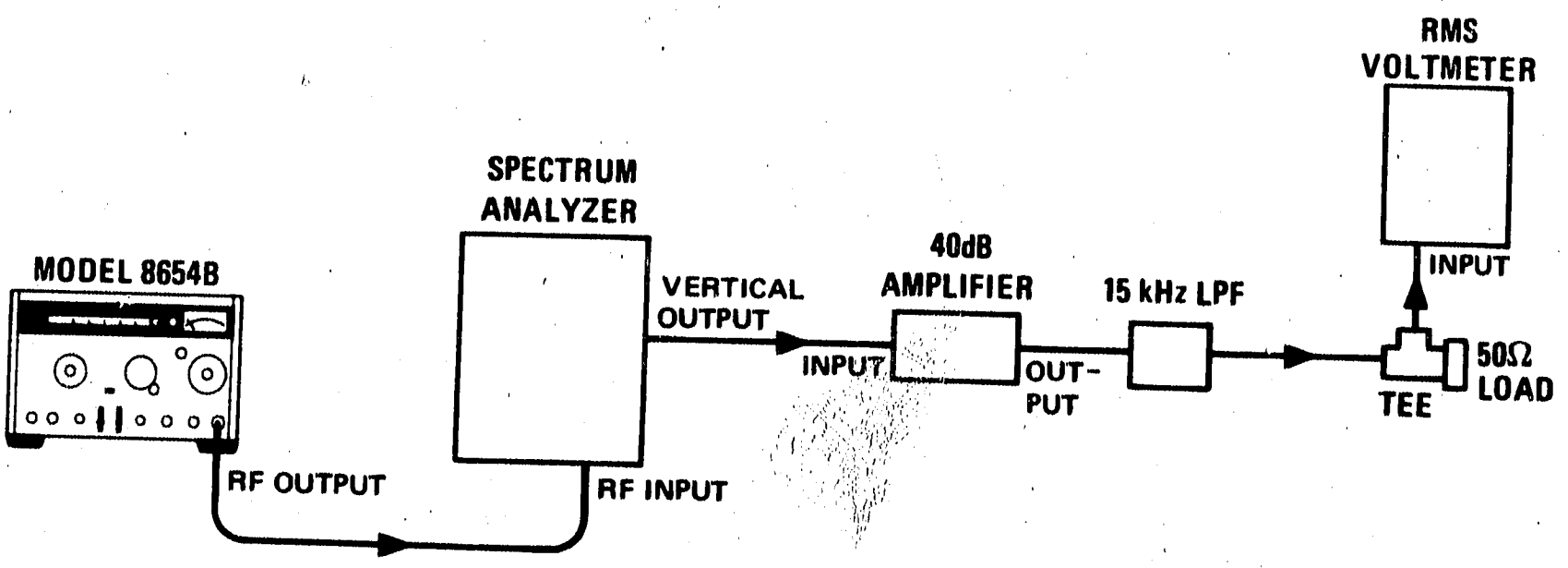


Figure 4-1. Residual AM Test Setup

PERFORMANCE TESTS

4-15. RESIDUAL AM TEST (Cont'd)

EQUIPMENT:

Spectrum Analyzer	HP 8558B/182C, Opt. 807
40 dB Amplifier	HP 465A
RMS Voltmeter	HP 3400A
15 kHz Low-Pass Filter	CIR-Q-TEL 7 Pole
50Ω Load	HP 11593A

PROCEDURE:

1. Connect equipment as shown in Figure 4-1 after setting Signal Generator controls as follows:

METER	LEVEL
FREQUENCY RANGE (MHz)	270—520 MHz
FREQUENCY TUNE	500 MHz
OUTPUT LEVEL Switch	—40 dBm
Output Level VERNIER	Meter reads 0 dB
AM	INTERNAL
AM LEVEL	Fully ccw
FM	OFF
400 Hz/1 kHz	1 kHz

2. Set spectrum analyzer resolution bandwidth to 300 kHz or greater, optimum input level to —40 dBm (0 dB attenuation), vertical scale to linear, display smoothing to minimum (off) and adjust frequency controls to center 500 MHz signal on display. Set frequency span to 0, fine adjust frequency controls to peak signal on display. Adjust vertical reference level controls to bring signal level to approximately the fifth graticule line from the bottom.

3. Set METER to AM and adjust AM LEVEL for a panel meter reading of 10%.

4. Readjust analyzer vertical scale control to a convenient reference on voltmeter's dB scale. This reference is 20 dB down from the carrier.

NOTE

If amplifier clipping is suspected, check the voltmeter input with an oscilloscope. If it is clipping, set the amplifier gain to 20 dB.

5. Set AM to OFF. Voltmeter average reading should drop more than 35 dB (i.e., more than 55 dB down from carrier).

35 dB_____

4-16. RESIDUAL FM TEST

SPECIFICATION: **Residual FM on CW** (averaged rms deviation): <0.3 ppm in a 0.3 to 3 kHz post-detection noise bandwidth. <0.5 ppm in a 50 Hz to 15 kHz post-detection noise bandwidth.

DESCRIPTION: The residual FM present on the Signal Generator output is demodulated by an FM frequency meter whose discriminator output is amplified and measured with a true rms voltmeter. A filter at the voltmeter input defines the measurement bandwidth. A ref-

PERFORMANCE TESTS

4-16. RESIDUAL FM TEST (Cont'd)

erence generator and mixer convert the RF output of the test Signal Generator to within the range of the frequency meter.

NOTE

The residual FM of the reference generator should be less than 1/3 of that specified for the 8654B since the test measures the residual FM of both generators simultaneously. Also, both generators should be free from mechanical vibrations and loud noises for this test. Residual FM is measured for a 50 Hz to 15 kHz post-detection noise bandwidth only since any out-of-tolerance condition for it will also be out of tolerance for a 100 Hz to 3 kHz bandwidth.

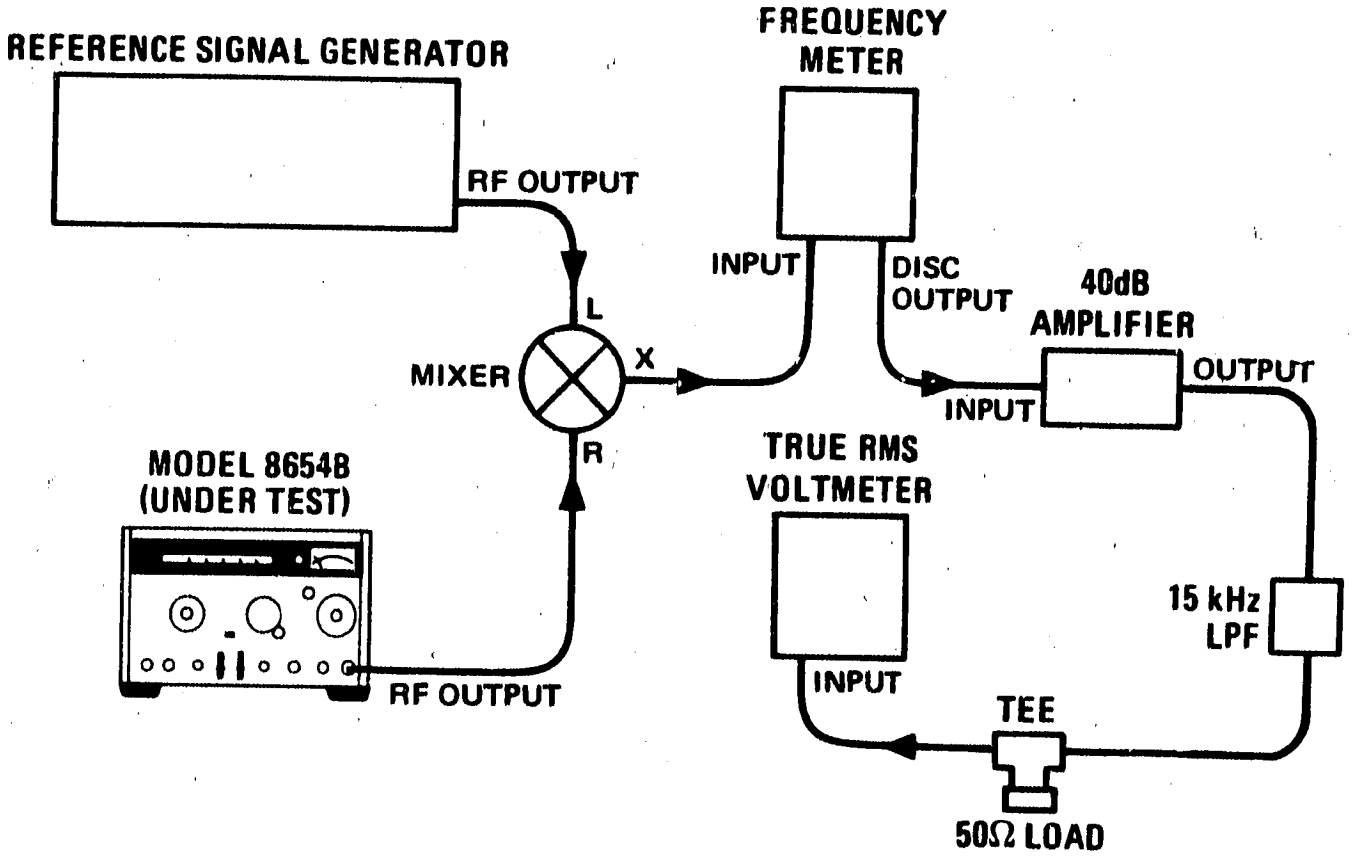


Figure 4-2. Residual FM Test Setup

EQUIPMENT:

Frequency Meter	HP 5210A
Filter Kit (for Frequency Meter)	HP 10531A
RMS Voltmeter	HP 3400A
40 dB Amplifier	HP 465A
Reference Signal Generator	HP 8640A
Mixer	HP 10514A
15 kHz Low-pass Filter	CIR-Q-TEL 7 Pole
50 Ohm Load	HP 11593A

PROCEDURE:

1. Set test Signal Generator controls as follows:

METER	LEVEL
FREQUENCY RANGE (MHz)	270—520 MHz
FREQUENCY TUNE	500 MHz
OUTPUT LEVEL Switch	—10 dBm
Output Level VERNIER	Meter reads 0 dB
AM	OFF
FM	OFF

PERFORMANCE TESTS

4-16. RESIDUAL FM TEST (Cont'd)

2. Install shorting board in frequency meter and calibrate for 1 Vdc (at output jack) for a full-scale meter reading.

3. Install 100 kHz Butterworth low-pass filter in frequency meter.

4. Connect equipment as shown in Figure 4-2.

5. Set reference signal generator to +7 dBm at 501 MHz. Set frequency meter range to 1 MHz.

6. Tune reference signal generator for a near full-scale reading on frequency meter.

7. Average voltmeter reading should be less than 12.5 mVrms (250 Hz—rms, or 0.5 ppm).

_____12.5 mVrms

NOTE

Test setup calibration can be checked by setting FM to INTERNAL, FM RANGE to 3 kHz, and FM LEVEL for 1 kHz as read on panel FM meter. Voltmeter should read approximately 35.4 mVrms. (The actual gain of the amplifier is 34 dB when terminated with 50Ω.)

4-17. OUTPUT LEVEL ACCURACY TEST

SPECIFICATION: **Range:** 10 dB steps and a 13 dB vernier provide power settings from +10 dBm to −130 dBm (0.7V to 0.07 μV) into 50Ω. For Option 003, maximum output level is +8 dBm (0.56V).

Level Accuracy:

	Using Top 10 dB of Vernier Range				Using Full Vernier Range
Output Level (dBm)	**+10* to −7**	**−7 to −57**	**−57 to −97**	**−97 to −127**	**+10* to −130**
Total Accuracy as Indicated on Level Meter (dB)	± 1.5	±2.0	± 2.5	± 3.0	Add ± 0.5

*For Option 003, maximum output level is +8 dBm (0.56V).

DESCRIPTION: The RF level accuracy for the +10 and 0 dBm ranges is measured with a power meter. For the lower ranges, a reference signal is established on a spectrum analyzer display, the Signal Generator OUTPUT LEVEL switch and the spectrum analyzer vertical scale log reference level control are stepped together and any amplitude variations appear on the analyzer display. An RF attenuator and amplifier at the RF OUTPUT are adjusted for analyzer compatibility and best sensitivity.

PERFORMANCE TESTS

4-17. OUTPUT LEVEL ACCURACY TEST (Cont'd)

NOTE

This measurement uses an IF substitution technique in which the spectrum analyzer IF is the standard. The IF step accuracy should be within ±0.2 dB overall. The IF step accuracy can be checked using the above technique by comparing a lab calibrated attenuator (such as HP Model 355D Option H36) with the IF step control at the frequency of attenuator calibration (e.g., 3 MHz for the HP 355D Option H36).

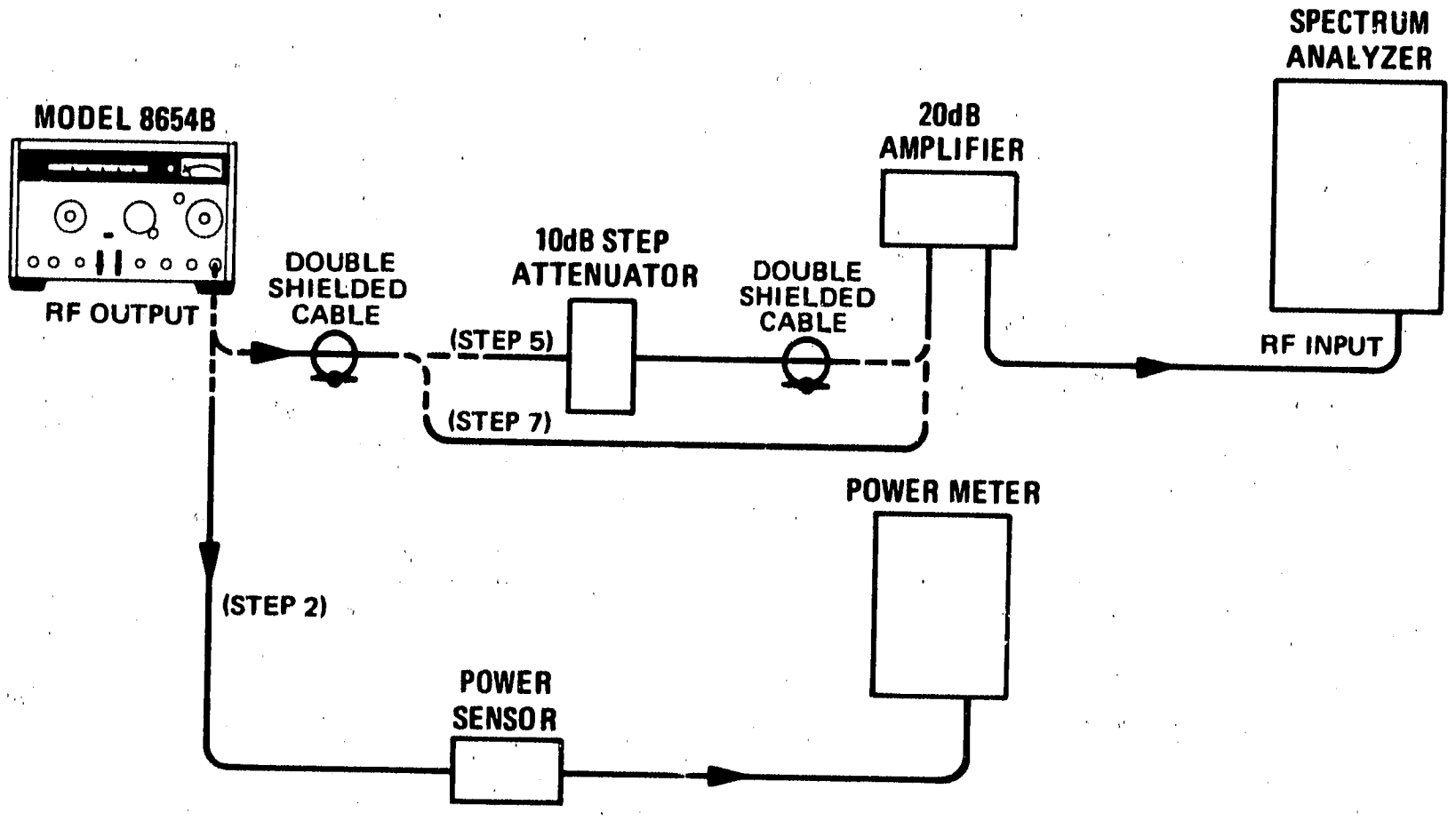


Figure 4-3. Output Level Accuracy Test Setup

EQUIPMENT:

Spectrum Analyzer	HP 8558B/182C
Power Meter/Sensor	HP 435A/8481A
20 dB Amplifier	HP 8447A
10 dB Step Attenuator	HP 355D
Double Shielded Cables (2 required)	HP 08708-6033

PROCEDURE:

1. Set Signal Generator controls as follows:

METER	LEVEL
FREQUENCY RANGE (MHz)	270—520 MHz
FREQUENCY TUNE	520 MHz
OUTPUT LEVEL Switch	+10 dBm
Output Level VERNIER	Meter reads 0 dB (Standard only) (—2 dB, Option 003 only)
AM	OFF
FM	OFF

2. Set power meter controls to +15 dBm range (+10 dBm range for Option 003). Connect power sensor to Signal Generator RF OUTPUT.

PERFORMANCE TESTS

4-17. OUTPUT LEVEL ACCURACY TEST (Cont'd)

3. Set Signal Generator RF OUTPUT level as shown in table below; verify that level is within the specified tolerance.

Signal Generator		Power Meter Reading (dBm)
OUTPUT LEVEL Switch (dBm)	Panel Meter Reading(dBm)	
+10	0 (except Option 003)	+8.5 _____ +11.5
	−2 (Option 003 only)	+6.5 _____ +9.5
	−3	+5.5 _____ +8.5
	−7	+1.5 _____ +4.5
	−10	−2.0 _____ +2.0
0	−10	−12.0 _____ −8.0
	−7	−8.5 _____ −5.5
	−3	−4.5 _____ −1.5
	0	−1.5 _____ +1.5
	+3	+1.5 _____ +4.5

4. Set step attenuator to 50 dB. Set spectrum analyzer center frequency to 520 MHz, resolution bandwidth to 10 kHz, frequency span to 5 kHz per division, optimum input level to −40 dBm (attenuation, 0 dB), display smoothing to approximately 100 Hz, 1 dB per division vertical log display with −20 dBm reference level.

5. Connect attenuator, amplifier, and spectrum analyzer together as shown in Figure 4-3, without disturbing generator controls. Center signal on display. Consider center horizontal scale equivalent to +3 dBm. With vertical reference level vernier, set signal peak to be equal to last measured level on power meter.

NOTE

If, for example, the last power meter reading was +2.6 dBm, the vertical scale resolution is 1 dB/division, therefore, the signal peak should be 0.4 dB or 0.4 division below the center scale reference.

6. Set Signal Generator OUTPUT LEVEL control and analyzer vertical scale log control as shown in the following table. Verify that amplitude falls within ±2.0 dB (2 divisions) of center scale reference in each case.

Signal Generator Output Level (dB)	Spectrum Analyzer	
	Log Reference (dBm)	Display Amplitude (dB)
0	−20	Set Level
−10	−30	−2.0 _____ +2.0
−20	−40	−2.0 _____ +2.0
−30	−50	−2.0 _____ +2.0
−40	−60	−2.0 _____ +2.0
−50	−70	−2.0 _____ +2.0

PERFORMANCE TESTS

4-17. OUTPUT LEVEL ACCURACY TEST (Cont'd)

7. Set analyzer's vertical reference level to −20 dBm. Remove 10 dB step attenuator and connect Signal Generator's RF OUTPUT directly to amplifier input. With vertical reference level vernier set signal peak to same level, with respect to horizontal center scale reference, as last measurement recorded on preceding table.

8. Set Signal Generator OUTPUT LEVEL control and analyzer vertical reference level as shown in the following table. Verify that amplitude is within tolerance specified.

Signal Generator Output Level (dBm)	Spectrum Analyzer	
	Log Reference (dBm)	Display Amplitude (dB)
−50	−20	Set Level
−60	−30	−2.5 _____ +2.5
−70	−40	−2.5 _____ +2.5
−80	−50	−2.5 _____ +2.5
−90	−60	−2.5 _____ +2.5
−100	−70	−3.0 _____ +3.0
−110	−80	−3.0 _____ +3.0
−120	−90	−3.0 _____ +3.0

NOTE

For the last step, set analyzer vertical scale to 10 dB/division and verify that noise level is at least 10 dB below signal.

4-18. OUTPUT LEVEL FLATNESS TEST

SPECIFICATION: **Level Flatness:** ±1 dB referenced to the output at 250 MHz for output levels >−7 dBm.

DESCRIPTION: An output level reference is established at 250 MHz and the maximum and minimum output levels are measured as the Signal Generator is tuned across each range. The test is performed at both maximum and minimum specified ALC reference levels.

EQUIPMENT: Power Meter and Sensor . . . . . HP 435A/8481A

PROCEDURE: 1. Set Signal Generator controls as follows:

METER	LEVEL
FREQUENCY RANGE (MHz)	130—270 MHz
FREQUENCY TUNE	250 MHz
OUTPUT LEVEL Switch	+10 dBm
Output Level VERNIER	Fully ccw
AM	OFF
FM	OFF

PERFORMANCE TESTS

4-18. OUTPUT LEVEL FLATNESS TEST (Cont'd)

2. Set power meter range to +10 dBm. Connect power sensor to Signal Generator RF OUTPUT.

3. Adjust Signal Generator Output Level VERNIER control for power meter reading of +9 dBm at 250 MHz (+7 dBm for Option 003).

4. Slowly tune Generator across each range and note maximum and minimum power readings for each range. The maximum should not exceed +10 dBm and the minimum should not be less than +8 dBm. (For Option 003 the maximum should not exceed +8 dBm and the minimum should not be less than +6 dBm.)

Frequency Range (MHz)	Power Meter Reading			
	Standard		Option 003	
	Minimum (dBm)	Maximum (dBm)	Minimum (dBm)	Maximum (dBm)
270—520	+8_____	_____ +10	+6 _____	_____ +8
130—270	+8 _____	_____ +10	+6 _____	_____ +8
66—130	+8 _____	_____ +10	+6 _____	_____ +8
35—66	+8 _____	_____ +10	+6 _____	_____ +8
19—35	+8 _____	_____ +10	+6 _____	_____ +8
10—19	+8 _____	_____ +10	+6 _____	_____ +8

5. Set Signal Generator frequency to 250 MHz; set OUTPUT LEVEL to 0 dBm and adjust VERNIER for panel meter reading of —7 dB.

6. Set power meter range to —5 dBm and adjust Signal Generator VERNIER for power meter reading of —7 dBm.

7. Slowly tune generator across each range and note maximum and minimum power meter readings for each range. The maximum should not exceed —6 dBm and the minimum should not be less than —8 dBm.

Frequency Range (MHz)	Power Meter Reading	
	Minimum (dBm)	Maximum (dBm)
270—520	—8 _____	_____ —6
130—270	—8 _____	_____ —6
66—130	—8 _____	_____ —6
35—66	—8 _____	_____ —6
19—35	—8 _____	_____ —6
10—19	—8 _____	_____ —6

PERFORMANCE TESTS

4-19. OUTPUT LEAKAGE TEST

SPECIFICATION: **Leakage** (with all RF outputs terminated properly):
Leakage limits are below those specified in MIL-1-6181D. Furthermore, with an output level <0.01V, less than 0.5 μV is induced in a 2-turn 25 mm (1-inch) diameter loop 25 mm (1-inch) away from any surface and measured into a 50Ω receiver.

DESCRIPTION: A loop antenna is held one inch from all surfaces of the Signal Generator and any leakage monitored with a spectrum analyzer. The loop antenna is suspended in a molding so that when the molding is in contact with a surface, the loop antenna is 25 mm (1 inch) from the surface.

NOTES

The use of a screen room may be necessary to reduce interference from other sources.

Do not grasp the antenna near the loop end while performing test.

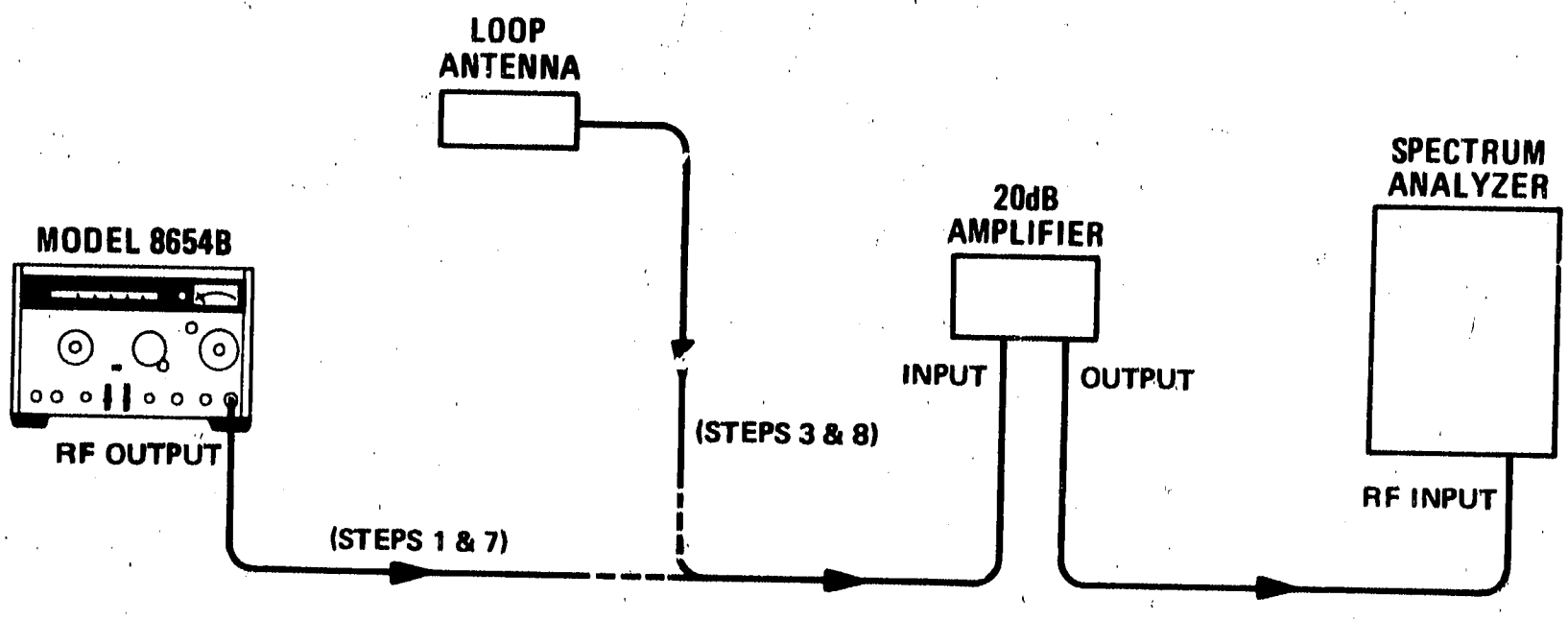


Figure 4-4. Output Leakage Test Setup

EQUIPMENT:

Loop Antenna	HP 08640-60501
20 dB Amplifier (0.1—400 MHz)	HP 8447A
20 dB Amplifier (400—1200 MHz)	HP 8447B
Spectrum Analyzer	HP 8558B/182C
50 Ohm Load (2 required)	HP 11593A

PROCEDURE:

1. Connect equipment as shown in Figure 4-4 (with Signal Generator connected to spectrum analyzer (through 0.1 to 400 MHz amplifier). Set generator controls as follows:

METER	LEVEL
FREQUENCY RANGE (MHz)	66—130 MHz
FREQUENCY TUNE	100 MHz
OUTPUT LEVEL Switch	—110 dBm
Output Level VERNIER	Meter reads —3 dB
AM	OFF
FM	OFF

PERFORMANCE TESTS

4-19. OUTPUT LEAKAGE TEST (Cont'd)

2. Set spectrum analyzer resolution bandwidth to 30 kHz, optimum input level to −40 dBm (0 dB attenuation), frequency span to 50 kHz per division, vertical scale to 10 dB per division log, display smoothing to approximately 100 Hz, and center frequency controls to locate 100 MHz signal. Use vertical reference level controls to set −113 dBm signal to −40 dB graticule line on display.

3. Disconnect generator from analyzer and connect 50 ohm loads to generator RF OUTPUT and rear panel AUX RF OUT connectors. Set analyzer frequency span to 20 MHz per division.

4. Connect loop antenna to analyzer through 0.1−400 MHz 20 dB amplifier. Hold the 25 mm (one-inch) side of loop antenna cylinder in contact with various surfaces of Signal Generator and observe display for the duration of a sweep. All signals and noise should be below −40 dB graticule line on display (i.e., less than −113 dBm or 0.5 μV) from 10 to 200 MHz.

_____ −40 dB

5. Set analyzer center frequency control to 300 MHz and repeat step 4. All signals and noise should be below −40 dB graticule line on display (i.e., less than −113 dBm or 0.5 μV) from 200−400 MHz.

_____ −40 dB

6. Replace amplifier with 400−1200 MHz 20 dB amplifier. Set analyzer center frequency controls to 500 MHz. Set generator FREQUENCY RANGE (MHz) to 270−520 MHz and FREQUENCY TUNE to 500 MHz.

7. Connect generator to analyzer and calibrate analyzer at 500 MHz as in step 2.

8. Re-terminate Signal Generator RF OUTPUT and connect loop antenna to amplifier. Set analyzer frequency span to 20 MHz per division.

9. Hold antenna in contact with various surfaces of Signal Generator and observe display. All signals and noise should be below −40 dB graticule line on display (i.e., less than −113 dBm or 0.5 μV) from 400−600 MHz.

_____ −40 dB

10. Set analyzer frequency to 700, 900, and 1100 MHz, and repeat step 9 at each setting. All signals and noise should be below −40 dB graticule line on display (i.e., less than −113 dBm or 0.5 μV).

600−800 MHz: _____ −40 dB
800−1000 MHz: _____ −40 dB
1000−1200 MHz: _____ −40 dB

PERFORMANCE TESTS

4-20. INTERNAL MODULATION RATE ACCURACY TEST

SPECIFICATION: **Modulation Rate:** Internal, 400 and 1000 Hz ±10%.

DESCRIPTION: The modulation oscillator frequency is measured at the AM and FM output jacks with a frequency counter.

EQUIPMENT: Frequency Counter . . . . . HP 5383A

PROCEDURE:

1. Connect counter high impedance input to AM OUTPUT jack. Set AM to INTERNAL and set 400 Hz/1 kHz switch to 400 Hz. Counter should read 400 ± 40 Hz.

   360 _____ 440 Hz

2. Set 400 Hz/1 kHz switch to 1 kHz. Counter should read 1000 ± 100 Hz.

   900 _____ 1100 Hz

3. Connect counter to FM OUTPUT jack. Set FM to INTERNAL. Counter should read 1000 ± 100 Hz.

   900 _____ 1100 Hz

4. Set 400 Hz/1 kHz switch to 400 Hz. Counter should read 400 ± 40 Hz.

   360 _____ 440 Hz

4-21. AM BANDWIDTH TEST

SPECIFICATION: External 3 dB bandwidth, dc coupled to >20 kHz.

DESCRIPTION: The Signal Generator is externally amplitude modulated by a test oscillator. The AM is demodulated with a spectrum analyzer in a zero span mode. The AM is observed directly on the display and any change in AM depth is observed as the modulation rate is increased.

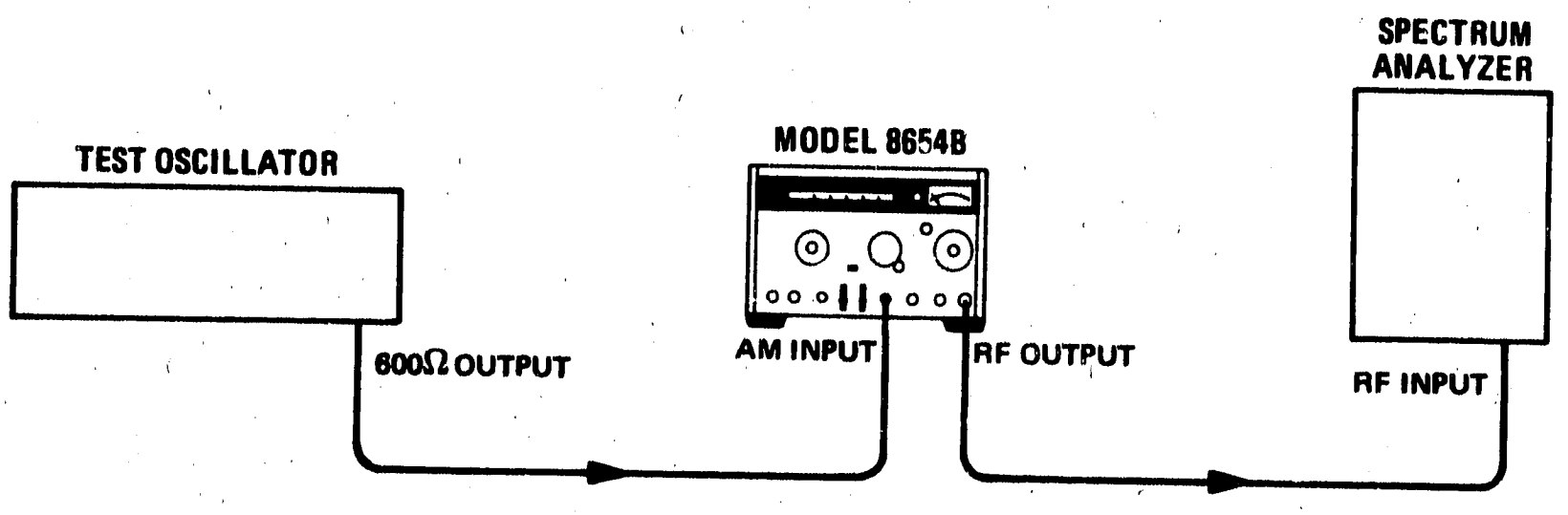


Figure 4-5. AM Bandwidth Test Setup

EQUIPMENT:

Spectrum Analyzer	HP 8558B/182C
Test Oscillator	HP 651B

PERFORMANCE TESTS

4-21. AM BANDWIDTH TEST (Cont'd)

PROCEDURE:

1. Connect equipment as shown in Figure 4-5 after setting Signal Generator controls as follows:

METER	LEVEL
FREQUENCY RANGE (MHz)	270—520 MHz
FREQUENCY TUNE	520 MHz
OUTPUT LEVEL Switch	—40 dBm
Output Level VERNIER	Meter reads +3 dB
AM	INTERNAL
AM LEVEL	Fully ccw
FM	OFF

2. Set spectrum analyzer resolution bandwidth to 300 kHz or greater, optimum input level to —40 dBm (0 dB attenuation), vertical scale to linear, display smoothing to minimum (off), and adjust center frequency controls to center 520 MHz signal on display. Set frequency span to 0; fine adjust frequency controls to peak signal on display. Adjust vertical reference level controls to bring signal level to fourth graticule line from bottom of display.

3. Set test oscillator to 1 kHz and approximately 1 Vrms into 600Ω.

4. Increase AM LEVEL until 4 divisions peak-to-peak of vertical deflection are obtained on display. (Internally trigger spectrum analyzer.)

5. Increase frequency of test oscillator to 20 kHz without changing its level. Peak-to-peak deflection on display should remain greater than 2.8 divisions for frequencies up to 20 kHz (i.e., >3 dB).

2.8 divisions _____

4-22. AM SENSITIVITY AND INDICATED ACCURACY TEST

SPECIFICATION: **External AM Sensitivity** (400 and 1000 Hz modulation rates):
(0.10 ± 0.01)% AM/mVpk into 600Ω with AM LEVEL vernier at fully cw position.
Indicated AM Accuracy (400 and 1000 Hz modulation rates):
± (5% of reading +5% of full scale).

DESCRIPTION: The Signal Generator is externally amplitude modulated by a test oscillator with a level set to give 50% AM. The AM is demodulated with a spectrum analyzer in a zero span mode. The AM depth is measured directly on the display and is compared with the panel meter reading.

PERFORMANCE TESTS

4-22. AM SENSITIVITY AND INDICATED ACCURACY TEST (Cont'd)

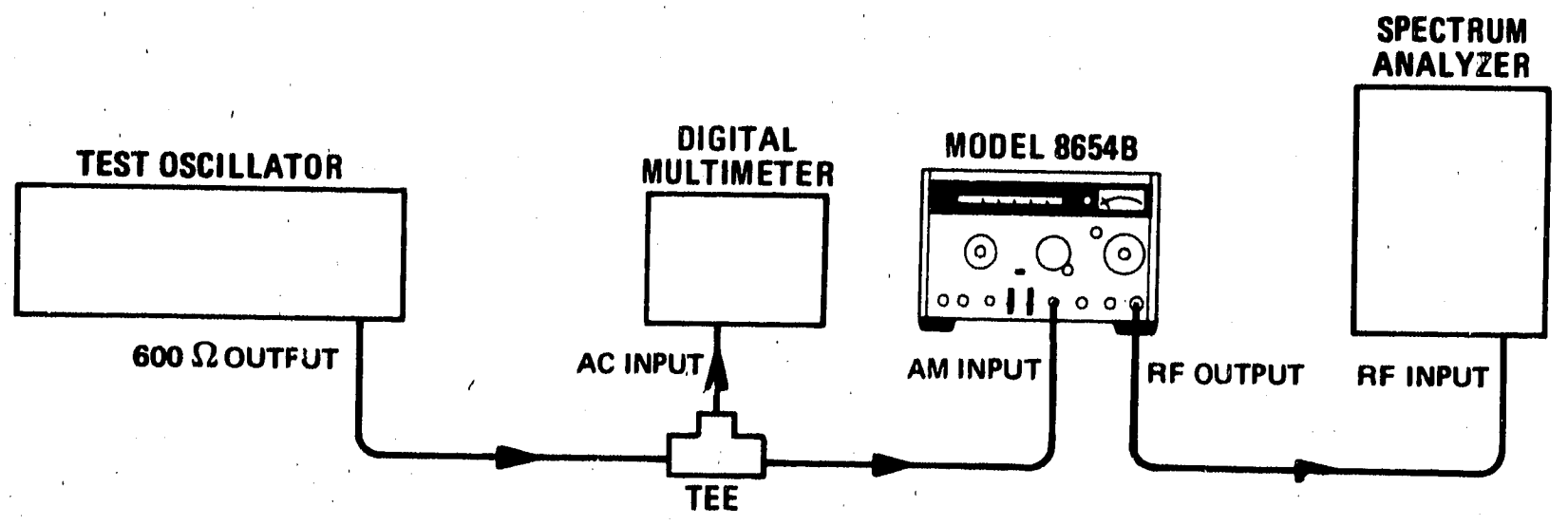


Figure 4-6. AM Sensitivity and Indicated Accuracy Test Setup

EQUIPMENT:

Spectrum Analyzer	HP 8558B/182C
Test Oscillator	HP 651B
Digital Multimeter	HP 34740A/34702A

PROCEDURE:

1. Connect equipment as shown in Figure 4-6 after setting Signal Generator controls as follows:

METER	LEVEL
FREQUENCY RANGE (MHz)	270—520 MHz
FREQUENCY TUNE	520 MHz
OUTPUT LEVEL Switch	—40 dBm
Output Level VERNIER	Meter reads +3 dB
AM	EXT
AM LEVEL	Fully cw
FM	OFF

2. Set spectrum analyzer resolution bandwidth to 300 kHz or greater, optimum input level to —40 dBm (0 dB attenuation), vertical scale to linear, display smoothing to between 10 and 50 kHz, and adjust center frequency controls to center 520 MHz signal on display. Set frequency span to 0; fine adjust frequency controls to peak signal on display. Adjust vertical reference level controls to bring signal level to fourth graticule line from bottom of display.

3. Set test oscillator to 1 kHz and 0.353 Vrms (0.5 Vpk) as read on ac voltmeter.

4. Peak-to-peak deflection on display should be between 3.6 and 4.4 divisions (corresponding to 50 ±5% AM).

3.6 _____ 4.4 divisions

NOTE

Check spectrum analyzer base line position by removing RF input. Base line should be exactly on bottom graticule line.

5. Adjust both test oscillator level and spectrum analyzer vertical level as needed for signal to span the second and sixth graticule lines from the bottom of display.

PERFORMANCE TESTS

4-22. AM SENSITIVITY AND INDICATED ACCURACY TEST (Cont'd)

6. Set METER to AM. Meter should read between 42.5% and 57.5% (i.e., 50.0 ± 7.5% AM).

42.5% _____ 57.5%

4-23. AM DISTORTION TEST

SPECIFICATION: **Envelope Distortion** (400 and 1000 Hz modulation rates): <3%, 0 to 70% modulation; <5%, 70 to 90% modulation.

DESCRIPTION: The Signal Generator is internally amplitude modulated. The AM is demodulated with a spectrum analyzer in a zero-frequency span mode. The distortion of the demodulated signal (present at the vertical output of the spectrum analyzer) is measured with a distortion analyzer. The measurement is made at a low ALC reference level where AM distortion is typically greatest.

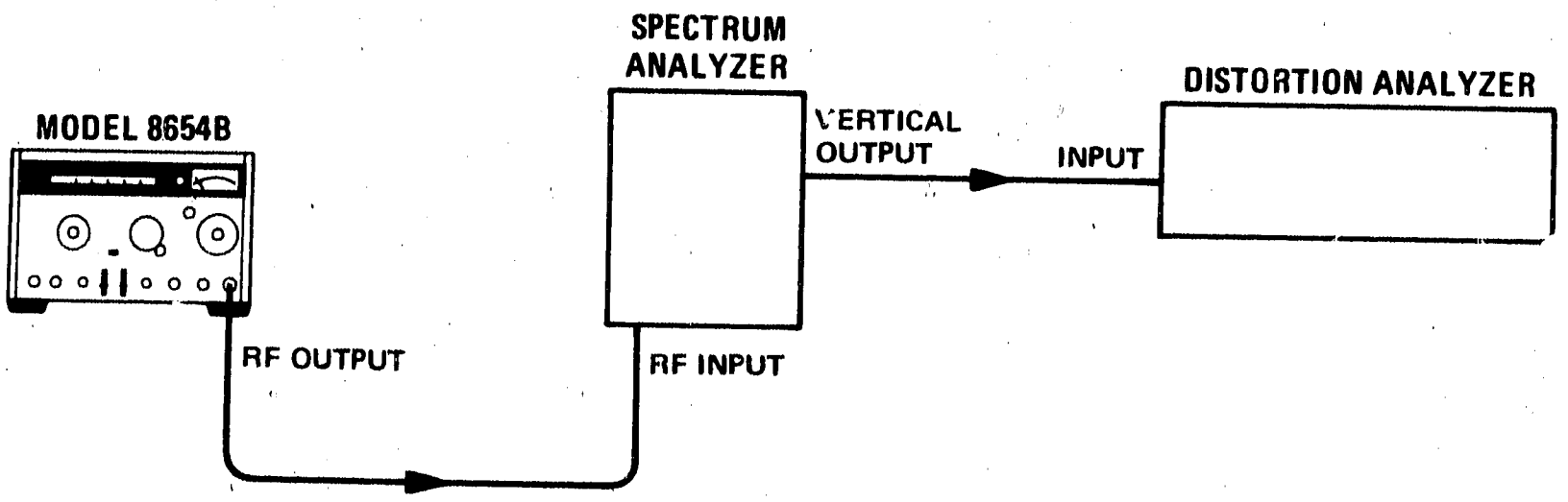


Figure 4-7. AM Distortion Test Setup

EQUIPMENT:

Spectrum Analyzer	HP 8558B/182C Opt. 807
Distortion Analyzer	HP 331A

PROCEDURE:

1. Connect equipment as shown in Figure 4-7 after setting Signal Generator controls as follows:

METER	LEVEL
FREQUENCY RANGE (MHz)	270—520 MHz
FREQUENCY TUNE	520 MHz
OUTPUT LEVEL Switch	—30 dBm
Output Level VERNIER	Meter reads —7 dB
AM	INTERNAL
AM LEVEL	Fully ccw
FM	OFF
400 Hz/1 kHz switch	1 kHz

2. Set spectrum analyzer resolution bandwidth to 300 kHz or greater, optimum input level to —40 dBm (0 dB attenuation), vertical scale to linear, and adjust center frequency controls to center 520 MHz signal on display. Set frequency span to 0;

PERFORMANCE TESTS

4-23. AM DISTORTION TEST (Cont'd)

fine adjust frequency controls to peak signal on display. Adjust vertical reference level controls to center signal on display. Set display smoothing to between 10 and 50 kHz.

3. Adjust AM LEVEL for front panel meter reading of 70% AM when METER is set to AM.

4. Calibrate distortion analyzer to measure distortion which should be less than 3%.

_____ 3%

5. Increase AM LEVEL to 90% as read on panel meter.

6. Recalibrate distortion analyzer. Distortion should be less than 5%.

_____ 5%

4-24. FM BANDWIDTH TEST

SPECIFICATION: External 3 dB bandwidth, dc coupled to >25 kHz.

DESCRIPTION: The Signal Generator is frequency modulated by an external signal. The FM signal is demodulated by a frequency meter whose discriminator output is measured with a voltmeter. A reference level is set at a 1 kHz rate. The rate is then increased to 25 kHz and the level rechecked. A reference generator and mixer convert the RF output of the test Signal Generator to within the range of the frequency meter. A low-pass filter at the mixer output prevents the frequency meter from mistriggering on the upper sideband generated by the mixer when the RF signal frequency is low.

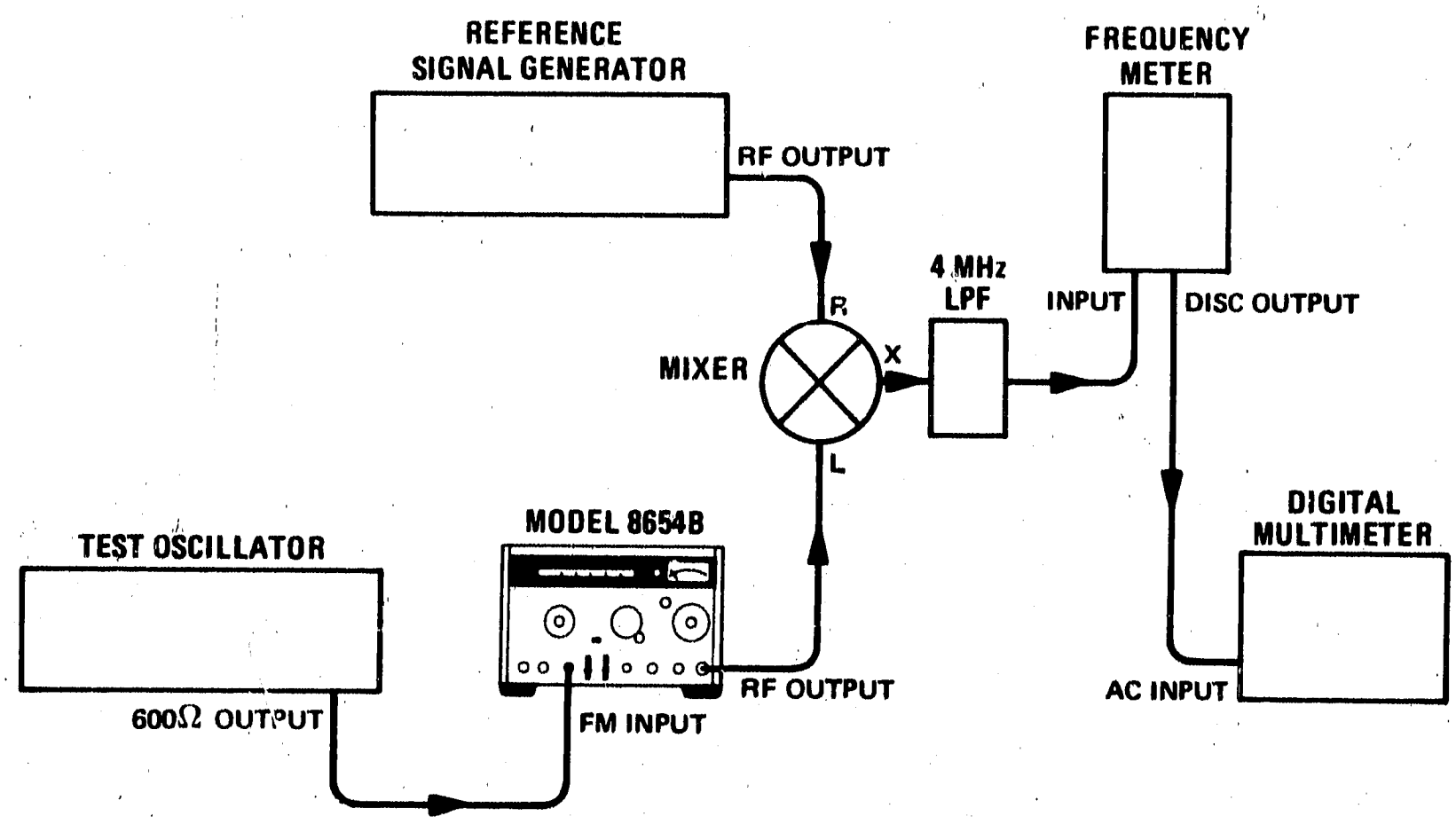


Figure 4-8. FM Bandwidth Test Setup

PERFORMANCE TESTS

4-24. FM BANDWIDTH TEST (Cont'd)

EQUIPMENT:

Frequency Meter	HP 5210A
Filter Kit (for Frequency Meter)	HP 10531A
Digital Multimeter	HP 34702A/34740A
Signal Generator (reference)	HP 8640A
Test Oscillator	HP 651B
Mixer	HP 10514A
4 MHz Low-Pass Filter	CIR-Q-TEL 3 Pole

PROCEDURE:

1. Install a 100 kHz Butterworth low-pass filter in frequency meter.

2. Connect equipment as shown in Figure 4-8 after setting test Signal Generator controls as follows:

METER	LEVEL
FREQUENCY RANGE (MHz)	10—19 MHz
FREQUENCY TUNE	10 MHz
OUTPUT LEVEL Switch	+10 dBm
Output Level VERNIER	Meter reads —3 dB
AM	OFF
FM	EXT
FM RANGE (kHz)	30 kHz
FM LEVEL	Fully cw

3. Set reference signal generator for a —7 dBm signal at 11 MHz.

4. Set frequency meter to trigger on input signal; set frequency range to 1 MHz. Fine tune reference signal generator for an on-scale frequency meter reading of approximately 0.8 MHz.

NOTE

If any readings appear to be highly erroneous, check the triggering on the frequency meter. The discriminator output should also be monitored on an oscilloscope and should appear as a pure sinewave.

5. Set test oscillator for a 1 kHz signal and adjust level for voltmeter reading of 20 mVrms (corresponding to 28.2 kHz frequency deviation).

6. Set test oscillator to 25 kHz. Voltmeter should read greater than 14.1 mVrms (less than 3 dB down from reference).

14.1 mVrms _____

7. Set test Signal Generator frequency to 80 MHz; set FM RANGE (kHz) to 100 kHz. Set reference signal generator frequency to 81 MHz; fine tune for a frequency meter reading of approximately 0.8 MHz.

PERFORMANCE TESTS

4-24. FM BANDWIDTH TEST (Cont'd)

8. Set test oscillator for a 1 kHz signal and adjust level for a voltmeter reading of 70.7 mVrms (corresponding to 100 kHz frequency deviation).

9. Set test oscillator to 25 kHz. Voltmeter should read greater than 50 mVrms (less than 3 dB down from reference).

50 mVrms_____

4-25. FM DISTORTION TEST

SPECIFICATION: **FM Distortion** (400 and 1000 Hz modulation rates): <2% for deviations up to 30 kHz, <3% for deviations up to 100 kHz.

DESCRIPTION: The Signal Generator is frequency modulated internally at a 1 kHz rate. The FM signal is demodulated by a frequency meter whose discriminator output is checked with a distortion analyzer. A reference generator and mixer convert the RF output of the test Signal Generator to within the range of the frequency meter. A low-pass filter at the mixer output prevents the frequency meter from mistriggering on the upper sideband generated by the mixer when the RF signal frequency is low.

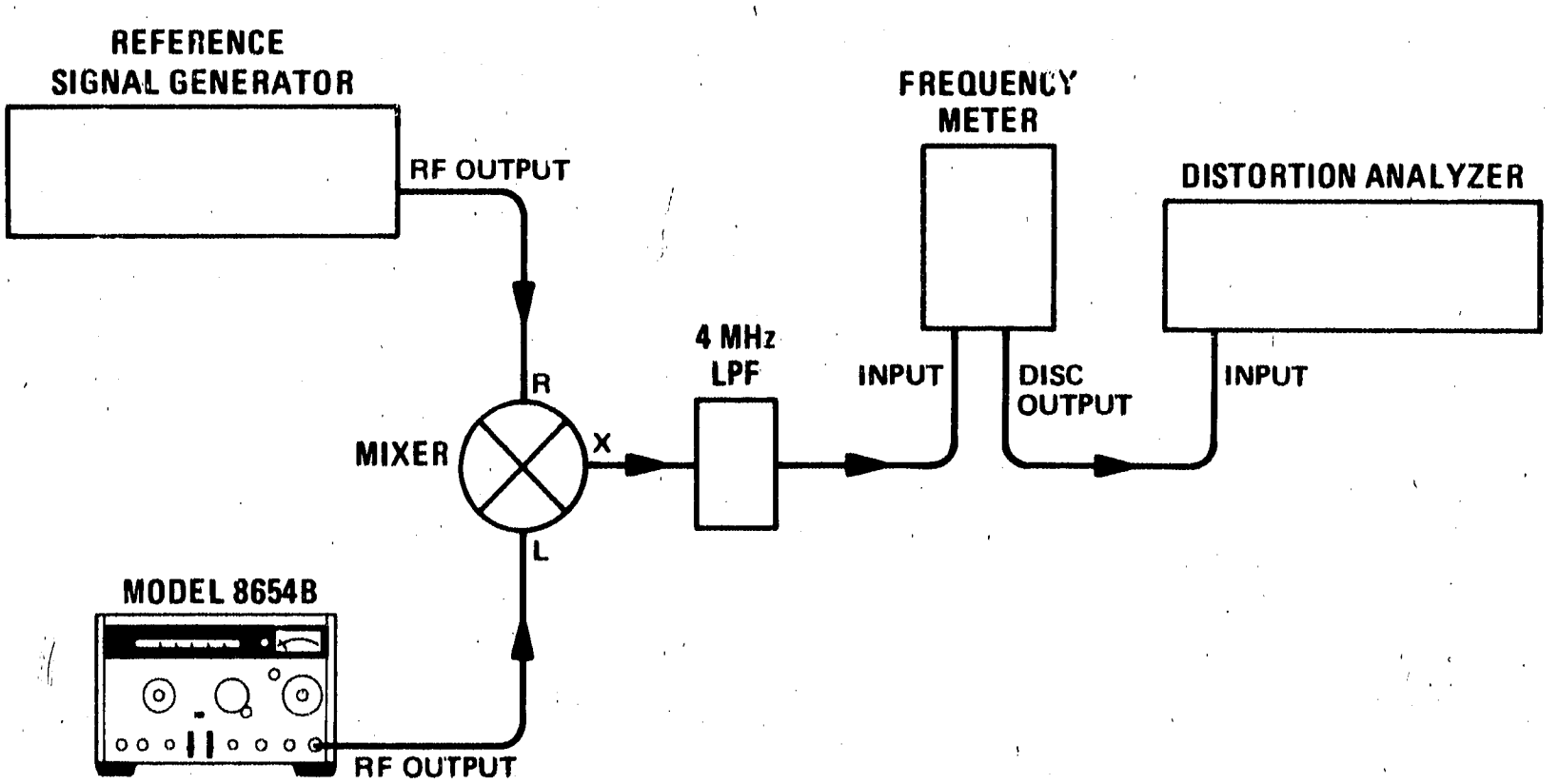


Figure 4-9. FM Distortion Test Setup

EQUIPMENT:

Frequency Meter	HP 5210A
Filter Kit (for Frequency Meter)	HP 10531A
Distortion Analyzer	HP 331A
Signal Generator (reference)	HP 8640A
Mixer	HP 10514A
4 MHz Low-Pass Filter	CIR-Q-TEL 3 Pole

PROCEDURE:

1. Install a 10 kHz Butterworth low-pass filter in frequency meter.
2. Connect equipment as shown in Figure 4-9 after setting test Signal Generator controls as follows:

PERFORMANCE TESTS

4-25. FM DISTORTION TEST (Cont'd)

METER	LEVEL
FREQUENCY RANGE (MHz)	10—19 MHz
FREQUENCY TUNE	10 MHz
OUTPUT LEVEL	+7 dBm
AM	OFF
FM	INTERNAL
FM RANGE (kHz)	30 kHz
FM LEVEL	Fully ccw
400 Hz/1 kHz switch	1 kHz

3. Set reference signal generator for a —7 dBm signal at 11 MHz.
4. Set METER to FM and FM LEVEL for a panel meter reading of 30 kHz.
5. Set frequency meter to trigger on input signal; set frequency range to 1 MHz. Fine tune reference signal generator for an on-scale frequency meter reading of approximately 0.8 MHz.
6. Set test and reference generators to the following frequencies. For each setting, fine tune reference generator to obtain frequency meter reading of approximately 0.8 MHz. Calibrate distortion analyzer for 1 kHz signal and measure distortion which should be less than 2%.

NOTES

The set level on the distortion analyzer will need to be set to a low range because of the low level of the discriminator output. This level becomes the 100% level. Also, this calibration need be re-checked only if the reading is suspect.

If any reading appears to be highly erroneous, check the triggering on the frequency meter. The discriminator output should also be monitored on an oscilloscope and should appear as a pure sinewave.

If a frequency meter filter greater than 10 kHz is used, the noise in the system may add to the distortion analyzer reading.

RANGE (MHz)	FREQUENCY TUNE	Ref. Gen. Frequency	Distortion
10—19	10 MHz 14 MHz 19 MHz	11 MHz 15 MHz 20 MHz	_____ 2% _____ 2% _____ 2%
19—35	19 MHz 27 MHz 35 MHz	20 MHz 28 MHz 36 MHz	_____ 2% _____ 2% _____ 2%
35—66	35 MHz 50 MHz 66 MHz	36 MHz 51 MHz 67 MHz	_____ 2% _____ 2% _____ 2%
66—130	66 MHz	67 MHz	_____ 2%

PERFORMANCE TESTS

4-25. FM DISTORTION TEST (Cont'd)

7. Set FM RANGE (kHz) to 100 kHz and adjust FM LEVEL for a panel meter reading of 100 kHz. Recalibrate distortion analyzer for 1 kHz and continue using settings listed below. Distortion should be less than 3%.

RANGE (MHz)	FREQUENCY TUNE	Ref. Gen. Frequency	Distortion
66–130	80 MHz	79 MHz	_____ 3%
	130 MHz	129 MHz	_____ 3%
130–270	130 MHz	129 MHz	_____ 3%
	190 MHz	189 MHz	_____ 3%
	270 MHz	269 MHz	_____ 3%
270–520	270 MHz	269 MHz	_____ 3%
	400 MHz	399 MHz	_____ 3%
	520 MHz	519 MHz	_____ 3%

4-26. FM SENSITIVITY AND METER ACCURACY TEST

SPECIFICATION: **External FM Sensitivity** (400 and 1000 Hz modulation rates): 1 volt peak yields maximum deviation indicated on peak deviation meter with FM LEVEL vernier at fully cw position.

Sensitivity Accuracy (15° to 35°C, 400 and 1000 Hz modulation rates): ±12%. For 100 kHz deviation above 130 MHz, ±15%.

Indicated FM Accuracy (15° to 35°C, 400 and 1000 Hz modulation rates): ±12% of reading +3% of full scale). For 100 kHz deviation above 130 MHz add 3% of reading.

DESCRIPTION: The Signal Generator is frequency modulated by an externally applied 1 Vpk signal. The FM signal is demodulated by a frequency meter whose discriminator output is measured with a voltmeter. A reference generator and mixer convert the RF output of the test Signal Genrator to within the range of the frequency meter. A low-pass filter at the mixer output prevents the frequency meter from mistriggering on the upper sideband generated by the mixer when the RF signal frequency is low.

PERFORMANCE TESTS

4-26. FM SENSITIVITY AND METER ACCURACY TEST (Cont'd)

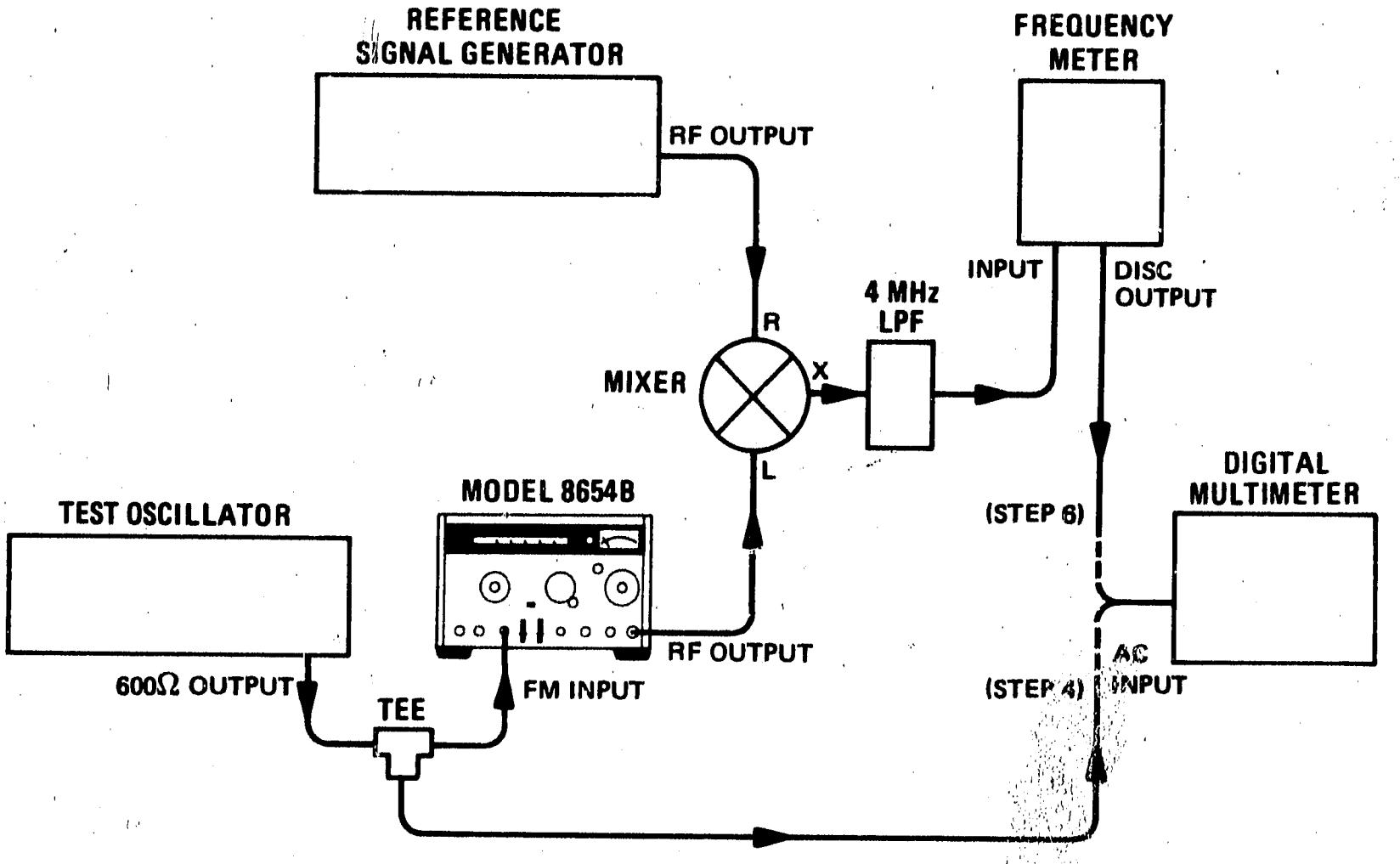


Figure 4-10. FM Sensitivity and Meter Accuracy Test Setup

EQUIPMENT:

Frequency Meter	HP 5210A
Filter Kit (for Frequency Meter)	HP 10531A
Digital Multimeter	HP 34702A/34740A
Signal Generator (reference)	HP 8640A
Test Oscillator	HP 651B
Mixer	HP 10514A
4 MHz Low-Pass Filter	CIR-Q-TEL 3 Pole

PROCEDURE:

1. Install shorting board in frequency meter and calibrate it for 1 Vdc at output jack for a full-scale meter reading. Remove shorting board and install a 100 kHz Butterworth low-pass filter.

2. Connect equipment as shown in Figure 4-10 after setting test Signal Generator controls as follows:

METER	LEVEL
FREQUENCY RANGE (MHz)	10—19 MHz
FREQUENCY TUNE	10 MHz
OUTPUT LEVEL Switch	+10 dBm
Output Level VERNIER	Meter reads —3 dB
AM	OFF
FM	EXT
FM RANGE (kHz)	30 kHz
FM LEVEL	Fully cw
400 Hz/1 kHz switch	1 kHz

PERFORMANCE TESTS

4-26. FM SENSITIVITY AND METER ACCURACY TEST (Cont'd)

3. Set reference signal generator for a −7 dBm signal at 11 MHz.

4. Set test oscillator for a 1 kHz signal and adjust level for voltmeter reading of 0.707 Vrms (1 Vpk).

5. Set frequency meter to trigger on input signal; set frequency range to 1 MHz. Fine tune reference signal generator for an on-scale frequency meter reading of approximately 0.8 MHz.

6. Connect voltmeter to discriminator output of frequency meter.

7. Set test and reference generators to frequencies listed below. For each setting, fine tune reference generator to obtain frequency meter reading of approximately 0.8 MHz. Voltmeter should read between 19.7 and 25.0 mVrms (31.6 mVpk ± 12% which corresponds to 31.6 kHz ± 12% frequency deviation).

NOTE

If any readings appear to be highly erroneous, check the triggering on the frequency meter. The discriminator output should also be monitored on an oscilloscope and should appear as a pure sinewave.

RANGE (MHz)	FREQUENCY TUNE	Ref. Gen. Frequency	Voltmeter Limits (mVrms)
10—19	10 MHz 14 MHz 19 MHz	11 MHz 15 MHz 20 MHz	19.7 _____ 25.0 19.7 _____ 25.0 19.7 _____ 25.0
19—35	19 MHz 27 MHz 35 MHz	20 MHz 28 MHz 36 MHz	19.7 _____ 25.0 19.7 _____ 25.0 19.7 _____ 25.0
35—66	35 MHz 50 MHz 66 MHz	36 MHz 51 MHz 67 MHz	19.7 _____ 25.0 19.7 _____ 25.0 19.7 _____ 25.0
66—130	66 MHz	67 MHz	19.7 _____ 25.0

8. Set FM RANGE to 100 kHz and continue using the settings listed below. For frequencies below 130 MHz the voltmeter should read between 62.2 and 79.2 mVrms (100 mVpk ±12% which corresponds to 100 kHz ±12% frequency deviation). For frequencies above 130 MHz, the voltmeter should read between 60.1 and 81.3 mVrms (100 mVpk ±15% which corresponds to 100 kHz ±15% frequency deviation).

PERFORMANCE TESTS

4-26. FM SENSITIVITY AND METER ACCURACY TEST (Cont'd)

RANGE (MHz)	FREQUENCY TUNE	Ref. Gen. Frequency	Voltmeter Limits (mVrms)
66—130	80 MHz 130 MHz	79 MHz 129 MHz	62.2 _____ 79.2 62.2 _____ 79.2
130—270	130 MHz 190 MHz 270 MHz	129 MHz 189 MHz 269 MHz	60.1 _____ 81.3 60.1 _____ 81.3 60.1 _____ 81.3
270—520	270 MHz 400 MHz 520 MHz	269 MHz 399 MHz 519 MHz	60.1 _____ 81.3 60.1 _____ 81.3 60.1 _____ 81.3

9. Set METER to FM and FM to INTERNAL at 1 kHz. Adjust FM LEVEL for a reading of 10 (100 kHz) on test Signal Generator panel meter.

10. Continue as before using the following settings. For frequencies above 130 MHz, the voltmeter should read between 58.0 and 83.4 mVrms (100 mVpk ±18% which corresponds to 100 kHz ±18% frequency deviation). For frequencies below 130 MHz, the voltmeter should read between 60.1 and 81.3 mVrms (100 mVpk ±15% which corresponds to 100 kHz ±15% deviation).

RANGE (MHz)	FREQUENCY TUNE	Ref. Gen. Frequency	Voltmeter Limits (mVrms)
270—520	520 MHz 400 MHz 270 MHz	519 MHz 399 MHz 269 MHz	58.0 _____ 83.4 58.0 _____ 83.4 58.0 _____ 83.4
130—270	270 MHz 190 MHz 130 MHz	269 MHz 189 MHz 129 MHz	58.0 _____ 83.4 58.0 _____ 83.4 58.0 _____ 83.4
66—130	130 MHz 80 MHz	129 MHz 79 MHz	60.1 _____ 81.3 60.1 _____ 81.3

11. Set FM RANGE (kHz) to 30 kHz. If necessary adjust FM LEVEL to maintain a panel meter reading of 10 on the 10 scale which corresponds to 31.6 kHz deviation as read on 3 scale. Continue using settings listed below. Voltmeter should read between 19.0 and 25.7 mVrms (31.6 mVpk ±15% which corresponds to 31.6 kHz ±15% frequency deviation).

PERFORMANCE TESTS

4-26. FM SENSITIVITY AND METER ACCURACY TEST (Cont'd)

RANGE (MHz)	FREQUENCY TUNE	Ref. Gen. Frequency	Voltmeter Limits (mVrms)
66—130	66 MHz	67 MHz	19.0 _____ 25.7
35—66	66 MHz 50 MHz 35 MHz	67 MHz 51 MHz 36 MHz	19.0 _____ 25.7 19.0 _____ 25.7 19.0 _____ 25.7
19—35	35 MHz 27 MHz 19 MHz	36 MHz 28 MHz 20 MHz	19.0 _____ 25.7 19.0 _____ 25.7 19.0 _____ 25.7
10—19	19 MHz 14 MHz 10 MHz	20 MHz 15 MHz 11 MHz	19.0 _____ 25.7 19.0 _____ 25.7 19.0 _____ 25.7

Table 4-1. Performance Test Record (1 of 5)

Hewlett-Packard
Model 8654B
Signal Generator
Serial No.: _____

Tested By _____

Date _____

Para. No.	Test Description	Results		
		Min.	Actual	Max.
4-13.	**Frequency Accuracy Test**			
	Frequency Range / Dial Indication			
	270—520 MHz / 500	485.0 MHz	_____	515.0 MHz
	450	437.5 MHz	_____	464.5 MHz
	400	388.0 MHz	_____	412.0 MHz
	350	339.5 MHz	_____	360.5 MHz
	300	291.0 MHz	_____	309.0 MHz
	130—270 MHz / 130	126.1 MHz	_____	133.9 MHz
	150	145.5 MHz	_____	154.5 MHz
	170	164.9 MHz	_____	175.1 MHz
	190	184.3 MHz	_____	195.7 MHz
	210	203.7 MHz	_____	216.3 MHz
	230	223.1 MHz	_____	236.9 MHz
	250	242.5 MHz	_____	257.5 MHz
	270	261.9 MHz	_____	278.1 MHz
	66—130 MHz / 130	126.1 MHz	_____	133.9 MHz
	120	116.4 MHz	_____	123.6 MHz
	110	106.7 MHz	_____	113.3 MHz
	100	97.0 MHz	_____	103.0 MHz
	90	87.3 MHz	_____	92.7 MHz
	80	77.6 MHz	_____	82.4 MHz
	70	67.9 MHz	_____	72.1 MHz
	35—66 MHz / 35	34.0 MHz	_____	36.1 MHz
	40	38.8 MHz	_____	41.2 MHz
	45	43.7 MHz	_____	46.4 MHz
	50	48.5 MHz	_____	51.5 MHz
	55	53.4 MHz	_____	56.7 MHz
	60	58.2 MHz	_____	61.8 MHz
	65	63.1 MHz	_____	67.0 MHz
	19—35 MHz / 35	33.95 MHz	_____	36.05 MHz
	30	29.10 MHz	_____	30.90 MHz
	25	24.25 MHz	_____	25.75 MHz
	20	19.40 MHz	_____	20.60 MHz
	10—19 MHz / 10	9.70 MHz	_____	10.30 MHz
	12	11.64 MHz	_____	12.36 MHz
	14	13.58 MHz	_____	14.42 MHz
	16	15.52 MHz	_____	16.48 MHz
	18	17.46 MHz	_____	18.54 MHz

Table 4-1. Performance Test Record (2 of 5)

Para. No.	Test Description	Results		
		Min.	Actual	Max.
4-14.	**Harmonic Distortion Test** **Standard:** **Frequency Range**			
	270–520 MHz	20 dB	_____	
	130–270 MHz	20 dB	_____	
	66–130 MHz	20 dB	_____	
	35–66 MHz	20 dB	_____	
	19–35 MHz	20 dB	_____	
	10–19 MHz	20 dB	_____	
	Option 003:			
	270–520 MHz	15 dB	_____	
	130–270 MHz	15 dB	_____	
	66–130 MHz	15 dB	_____	
	35–66 MHz	15 dB	_____	
	19–35 MHz	15 dB	_____	
	10–19 MHz	15 dB	_____	
4-15.	**Residual AM Test**	35 dB	_____	
4-16.	**Residual FM Test** 50 Hz–15 kHz Noise BW		_____	12.5 mVrms
4-17.	**Output Level Accuracy Test**			
	Output Level Switch / **Meter**			
	+10 dBm / 0 dB (except Opt. 003)	+8.5 dBm	_____	+11.5 dBm
	−2 dB (Opt. 003 only)	+6.5 dBm	_____	+9.5 dBm
	−3 dB	+5.5 dBm	_____	+8.5 dBm
	−7 dB	+1.5 dBm	_____	+4.5 dBm
	−10 dB	−2.0 dBm	_____	+2.0 dBm
	0 dBm / −10 dB	−12.0 dBm	_____	−8.0 dBm
	−7 dB	−8.5 dBm	_____	−5.5 dBm
	−3 dB	−4.5 dBm	_____	−1.5 dBm
	0 dB	−1.5 dBm	_____	+1.5 dBm
	+3 dB	+1.5 dBm	_____	+4.5 dBm
	−10 dBm	−2.0 dB	_____	+2.0 dB
	−20 dBm	−2.0 dB	_____	+2.0 dB
	−30 dBm	−2.0 dB	_____	+2.0 dB
	−40 dBm	−2.0 dB	_____	+2.0 dB
	−50 dBm	−2.0 dB	_____	+2.0 dB
	−60 dBm	−2.5 dB	_____	+2.5 dB
	−70 dBm	−2.5 dB	_____	+2.5 dB
	−80 dBm	−2.5 dB	_____	+2.5 dB
	−90 dBm	−2.5 dB	_____	+2.5 dB

Table 4-1. Performance Test Record (3 of 5)

Para. No.	Description	Results		
		Min.	Actual	Max.
4-17. (cont'd)	**Output Level Accuracy Test (Cont'd)**			
	Output Level Switch **Meter**			
	−100 dBm	−3.0 dB	_____	+3.0 dB
	−110 dBm	−3.0 dB	_____	+3.0 dB
	−120 dBm	−3.0 dB	_____	+3.0 dB
4-18.	**Output Level Flatness Test**			
	Output Level **Frequency Range**			
	+9 dBm (except Opt. 003) 270–520 MHz	+8 dBm	_____ _____	+10 dBm
	130–270 MHz	+8 dBm	_____ _____	+10 dBm
	66–130 MHz	+8 dBm	_____ _____	+10 dBm
	35–66 MHz	+8 dBm	_____ _____	+10 dBm
	19–35 MHz	+8 dBm	_____ _____	+10 dBm
	10–19 MHz	+8 dBm	_____ _____	+10 dBm
	+7 dBm (Opt. 003 only) 270–520 MHz	+6 dBm	_____ _____	+8 dBm
	130–270 MHz	+6 dBm	_____ _____	+8 dBm
	66–130 MHz	+6 dBm	_____ _____	+8 dBm
	35–66 MHz	+6 dBm	_____ _____	+8 dBm
	19–35 MHz	+6 dBm	_____ _____	+8 dBm
	10–19 MHz	+6 dBm	_____ _____	+8 dBm
	−7 dBm (All instruments) 270–520 MHz	−8 dBm	_____ _____	−6 dBm
	130–270 MHz	−8 dBm	_____ _____	−6 dBm
	66–130 MHz	−8 dBm	_____ _____	−6 dBm
	35–66 MHz	−8 dBm	_____ _____	−6 dBm
	19–35 MHz	−8 dBm	_____ _____	−6 dBm
	10–19 MHz	−8 dBm	_____ _____	−6 dBm
4-19.	**Output Leakage Test**			
	10–200 MHz		_____	−40 dB
	200–400 MHz		_____	−40 dB
	400–600 MHz		_____	−40 dB
	600–800 MHz		_____	−40 dB
	800–1000 MHz		_____	−40 dB
	1000–1200 MHz		_____	−40 dB
4-20.	**Internal Modulation Rate Accuracy Test**			
	AM 400 Hz	360 Hz	_____	440 Hz
	AM 1 kHz	900 Hz	_____	1100 Hz
	FM 1 kHz	900 Hz	_____	1100 Hz
	FM 400 Hz	360 Hz	_____	440 Hz
4-21.	**AM Bandwidth Test**	2.8 div.	_____	

Table 4-1. Performance Test Record (4 of 5)

Para. No.	Description	Results		
		Min.	Actual	Max.
4-22.	**AM Sensitivity and Indicated Accuracy Test**			
	Sensitivity	3.6 div.	_____	4.4 div.
	Meter Accuracy	42.5%	_____	57.5%
4-23.	**AM Distortion Test**			
	0—70% AM		_____	3%
	70—90% AM		_____	5%
4-24.	**FM Bandwidth Test**			
	FM Range			
	30 kHz	14.1 mVrms	_____	
	100 kHz	50 mVrms	_____	
4-25.	**FM Distortion Test**			
	FM Range **Frequency Tune**			
	30 kHz 10 MHz		_____	2%
	14 MHz		_____	2%
	19 MHz		_____	2%
	19 MHz		_____	2%
	27 MHz		_____	2%
	35 MHz		_____	2%
	35 MHz		_____	2%
	50 MHz		_____	2%
	66 MHz		_____	2%
	66 MHz		_____	2%
	100 kHz 80 MHz		_____	3%
	130 MHz		_____	3%
	130 MHz		_____	3%
	190 MHz		_____	3%
	270 MHz		_____	3%
	270 MHz		_____	3%
	400 MHz		_____	3%
	520 MHz		_____	3%
4-26.	**FM Sensitivity and Meter Accuracy Test**			
	FM **FM Range** **Frequency Tune**			
	EXT 30 kHz 10 MHz	19.7 mVrms	_____	25.0 mVrms
	14 MHz	19.7 mVrms	_____	25.0 mVrms
	19 MHz	19.7 mVrms	_____	25.0 mVrms
	19 MHz	19.7 mVrms	_____	25.0 mVrms
	27 MHz	19.7 mVrms	_____	25.0 mVrms
	35 MHz	19.7 mVrms	_____	25.0 mVrms
	35 MHz	19.7 mVrms	_____	25.0 mVrms
	50 MHz	19.7 mVrms	_____	25.0 mVrms
	66 MHz	19.7 mVrms	_____	25.0 mVrms
	66 MHz	19.7 mVrms	_____	25.0 mVrms

Table 4-1. Performance Test Record (5 of 5)

Para. No.	Description	Results		
		Min.	Actual	Max.
4-26.	**FM Sensitivity and Meter Accuracy Test (cont'd)**			
	FM **FM Range** **Frequency Tune**			
	EXT 100 kHz 80 MHz	62.2 mVrms	_____	79.2 mVrms
	130 MHz	62.2 mVrms	_____	79.2 mVrms
	130 MHz	60.1 mVrms	_____	81.3 mVrms
	190 MHz	60.1 mVrms	_____	81.3 mVrms
	270 MHz	60.1 mVrms	_____	81.3 mVrms
	270 MHz	60.1 mVrms	_____	81.3 mVrms
	400 MHz	60.1 mVrms	_____	81.3 mVrms
	520 MHz	60.1 mVrms	_____	81.3 mVrms
	INTERNAL 100 kHz 520 MHz	58.0 mVrms	_____	83.4 mVrms
	400 MHz	58.0 mVrms	_____	83.4 mVrms
	270 MHz	58.0 mVrms	_____	83.4 mVrms
	270 MHz	58.0 mVrms	_____	83.4 mVrms
	190 MHz	58.0 mVrms	_____	83.4 mVrms
	130 MHz	58.0 mVrms	_____	83.4 mVrms
	130 MHz	60.1 mVrms	_____	81.3 mVrms
	80 MHz	60.1 mVrms	_____	81.3 mVrms
	30 kHz 66 MHz	19.0 mVrms	_____	25.7 mVrms
	66 MHz	19.0 mVrms	_____	25.7 mVrms
	50 MHz	19.0 mVrms	_____	25.7 mVrms
	35 MHz	19.0 mVrms	_____	25.7 mVrms
	35 MHz	19.0 mVrms	_____	25.7 mVrms
	27 MHz	19.0 mVrms	_____	25.7 mVrms
	19 MHz	19.0 mVrms	_____	25.7 mVrms
	19 MHz	19.0 mVrms	_____	25.7 mVrms
	14 MHz	19.0 mVrms	_____	25.7 mVrms
	10 MHz	19.0 mVrms	_____	25.7 mVrms

ADJUSTMENTS

SECTION V
ADJUSTMENTS

5-1. INTRODUCTION

5-2. This section describes the adjustments which will return the HP Model 8654B to peak operating conditions. The adjustments are to be performed whenever the performance test results are out of tolerance. This may occur over a period of time because of aging of components within the instrument or because of repair or replacement of certain components, parts, or assemblies. Table 5-2 contains information pertaining to assemblies or parts repaired or replaced, the performance tests which verify the Signal Generator is performing to its maximum capability, and the adjustments to be made if its performance is out of specification. Information is also provided in this section about the equipment required to perform the tests, instructions for locating the adjustable components, and factory-selected components.

5-3. All adjustment procedures include references to service sheets where the adjustable components are shown, a description of the test including any problem areas or special instructions, a test equipment setup diagram, where necessary, the test equipment recommended for the adjustment, and a step-by-step procedure for performing the adjustments. Removal and replacement procedures are given on the alphabetic service sheets (after the schematics in Section VIII). If an adjustable component is mounted on a printed circuit board, it will be shown on the component location diagram which accompanies each schematic.

5-4. SAFETY CONSIDERATIONS

5-5. Although this instrument has been designed in accordance with international safety standards, this manual contains information and warnings which must be followed to ensure safe operation and to retain the instrument in a safe condition (see Safety Considerations page in the front of the manual). Service and adjustments should be performed only by qualified service personnel.

WARNINGS

Any interruption of the protective (grounding) conductor inside or outside the instrument or disconnection of the protective earth terminal is likely to make the apparatus dangerous. Intentional interruption is prohibited.

Any adjustment, maintenance, and repair of the opened instrument under voltage should be avoided as much as possible and, when inevitable, should be carried out only by a skilled person who is aware of the hazard involved.

Removal of the top cover makes accessible hazardous voltage in the region of connector XA5 (~53 Vrms) and on the A5 FM Driver Board (~50 Vdc). Removal of the bottom cover makes accessible hazardous voltage at connector XA3 (~53 Vrms). Removal of the protective cover on the A4 Line Module exposes hazardous voltage (line voltage) at the module's terminals.

Capacitors inside the instrument may still be charged even if the instrument has been disconnected from its source of supply.

Make sure that only fuses with the required rated current and of the specified type (normal blow, time delay, etc.) are used for replacement. The use of repaired fuses and the short-circuiting of fuseholders must be avoided.

Whenever it is likely that the protection has been impaired, the instrument must be made inoperative and be secured against any unintended operation.

5-6. EQUIPMENT REQUIRED

5-7. The test equipment required for the adjustment procedures is listed in Table 1-2, Recommended Test Equipment. The critical specifications of substitute test instruments must meet or exceed the standards listed in the table if the performance of the generator is to meet the standards set forth in Table 1-1, Specifications.

5-8. Pozidriv Screwdrivers

5-9. Many screws in the instrument appear to be Phillips, but are not. To avoid damage to the screw slots, Pozidriv screwdrivers should be used.

5-10. Blade Tuning Tools

5-11. For adjustments requiring a non-metallic metal-blade tuning tool, use the J.F.D. Model No. 5284 (HP 8710-1010). In situations not requiring non-metallic tuning tools, an ordinary small screwdriver or other suitable tool is sufficient. No matter what tool is used, never try to force any adjustment control in the generator. This is especially critical when tuning variable slug-tuned inductors, and variable capacitors.

5-12. Extender Board. An extender board (HP 08640-60036) is available which can be used to extend the A3 Control/Power Supply Board Assembly for service.

5-13. FACTORY-SELECTED COMPONENTS

5-14. Factory-selected components are identified on the schematics and parts list by an asterisk (*) which follows the reference designator. The nominal value of the components is normally shown. The manual change sheets will provide updated information pertaining to the selected components.

Table 5-1 lists the reference designator, the criterion used for selecting a particular value, the normal value range, and the service sheet where the component part is shown.

5-15. POST REPAIR TESTS AND ADJUSTMENTS

5-16. The adjustments in this section should be performed when troubleshooting or performance tests indicate that an adjustable circuit is not operating correctly. Perform the adjustments *after* repairing or replacing the circuit. After making the adjustments, repeat the performance tests (found in Section IV) specified in the table. In general, if the RF Section casting was opened (or any RF connectors removed) during a repair, the Output Leakage Test should be performed. Performance tests should also be made for any assembly that had a component changed, even if the changed component was not defective. The power supplies should be checked whenever an assembly has been repaired.

NOTE

Table 5-2 can also be used for troubleshooting. If the generator failed one or more performance tests, cross-referencing to the associated assembly or circuitry will often indicate the source of the failure.

Table 5-1. Factory-Selected Components (1 of 2)

Reference Designator	Basis of Selection	Normal Value Range	Service Sheet
R6	Selected for a meter reading of <−10 dB with the output level VERNIER set fully ccw. The Meter Adjustments (paragraph 5-20) should be performed before resistor selection.	909−1000Ω	4
A1A1C4	(See A1A3C6 selection). If removing A1A3C6 does not solve the RF output flatness/harmonic problem, remove A1A1C4. Perform Harmonic Distortion Test (paragraph 4-14) and Output Level Flatness Test (paragraph 4-18).	0 or 6.8 pF	3
A1A1R1	Selected for harmonic levels within published specifications. After resistor selection, verify that RF output power is greater than +10 dBm (+8 dBm, Opt. 003).	133−147Ω	3
A1A1R15	Selected for harmonic levels within published specifications. After resistor selection, verify that RF output power is greater than +10 dBm (+8 dBm, Opt. 003).	61.9−133Ω	3
A1A1R28	Selected for harmonic levels within published specifications. After resistor selection, verify that RF output power is greater than +10 dBm (+8 dBm, Opt. 003).	147−215Ω	3
A1A1R31	Selected for output level flatness within specification on the 270−520 MHz range. If frequency response peaks out of specification on the high end of range, decrease value of the resistor.	90.9−121Ω	3

Table 5-1. Factory-Selected Components (2 of 2)

Reference Designator	Basis of Selection	Normal Value Range	Service Sheet
A1A3C6 (see note)	Selected for output level flatness and carrier harmonics within specifications (on the 270—520 MHz range). Normally, when the capacitor is removed, flatness is improved but harmonic content is increased. (See also A1A1C4 selection.) Perform Harmonic Distortion Test (paragraph 4-14) and Output Level Flatness Test (paragraph 4-18).	0 or 4.3 pF	2
A1A3C13 (see note)	Selected to provide A1A3C2 adequate adjustment range to lower maximum output frequency on 270—520 MHz range.	0—1.0 pF	2
A3C23	Selected for flattest response to external AM input frequencies on the top 10 dB of the output level VERNIER and for all settings of the MODULATION LEVEL control. Perform AM Bandwidth Test (paragraph 4-21).	10—200 pF	4
A3R53	Selected to provide correct meter reading in the +10 dBm OUTPUT LEVEL range. Perform Meter Adjustments (paragraph 5-20).	1330—1470Ω	4
A5R2 A5R4 A5R6 A5R8 A5R10 A5R12 A5R14 A5R22-25 A5R28-30 A5R33 A5R35 A5R38 A5R40 A5R44 A5R48 (see note)	Breakpoint, slope and exponent network resistors. Perform Preliminary FM Adjustments (paragraph 5-23), FM Distortion Adjustment (paragraph 5-24) and FM Deviation Adjustment (paragraph 5-25).	—	5
A5R66 A5R68 A5R70 A5R72 A5R74 A5R76 A5R84 A5R89 A5R91 (see note)	Exponent network, 100 kHz, 3 kHz, and 10 kHz resistors. Perform Preliminary FM Adjustments (paragraph 5-23), FM Distortion Adjustments (5-24), and FM Deviation Adjustment (paragraph 5-25).	—	6

NOTE

Replacing these components may require FM adjustments. FM adjustments are complex and time consuming and require special test equipment.

Table 5-2. Post Repair Tests and Adjustments (1 of 2)

Assembly, Circuit, or Part Repaired	Performance Test (After Repair Completed)	Adjustment Procedure (If Necessary)
All electrical repairs	--	Power Supply Adjustment (paragraph 5-17)
A1A1 RF Amplifier/ALC Board Assembly	Output Level Accuracy Test (paragraph 4-17) Output Level Flatness Test (paragraph 4-18) AM Sensitivity and Indicated Accuracy Test (paragraph 4-22) AM Distortion Test (paragraph 4-23)	Detector Bias and AM Distortion Adjustment (paragraph 5-18) AM Sensitivity Adjustment (paragraph 5-19) Meter Adjustments (paragraph 5-20)
A1A2 FM Modulator Board Assembly (see note)	Frequency Accuracy Test (paragraph 4-13) FM Distortion Test (paragraph 4-25) FM Sensitivity and Meter Accuracy Test (paragraph 4-26)	Tuning Capacitor and Pulley Adjustment (paragraph 5-21) Frequency Adjustment (paragraph 5-22) Preliminary FM Adjustments (paragraph 5-23) FM Distortion Adjustment (paragraph 5-24) FM Deviation Adjustment (paragraph 5-25)
A1A3 RF Oscillator Board Assembly (see note)	Frequency Accuracy Test (paragraph 4-13) FM Distortion Test (paragraph 4-25) FM Sensitivity and Meter Accuracy Test (paragraph 4-26)	Frequency Adjustment (paragraph 5-22) Preliminary FM Adjustments (paragraph 5-23) FM Distortion Adjustment (paragraph 5-24) FM Deviation Adjustment (paragraph 5-25)
A1A4 Turret Assembly (see note)	Frequency Accuracy Test (paragraph 4-13) FM Distortion Test (paragraph 4-25) FM Sensitivity and Meter Accuracy Test (paragraph 4-26)	Frequency Adjustment (paragraph 5-22) Preliminary FM Adjustments (paragraph 5-23) FM Distortion Adjustment (paragraph 5-24) FM Deviation Adjustment (paragraph 5-25)
A1C3 Tuning Capacitor (see note)	Frequency Accuracy Test (paragraph 4-13) FM Distortion Test (paragraph 4-25) FM Sensitivity and Meter Accuracy Test (paragraph 4-26)	Tuning Capacitor and Pulley Adjustment (paragraph 5-21) Frequency Adjustment (paragraph 5-22) Preliminary FM Adjustments (paragraph 5-23) FM Distortion Adjustment (paragraph 5-24) FM Deviation Adjustment (paragraph 5-25)

Table 5-2. Post Repair Tests and Adjustments (2 of 2)

Assembly, Circuit, or Part Repaired	Performance Test (After Repair Completed)	Adjustment Procedure (If Necessary)
Dial Stringing (see note)	Frequency Accuracy Test (paragraph 4-13)	Tuning Capacitor and Pulley Adjustment (paragraph 5-21) Frequency Adjustment (paragraph 5-22) Preliminary FM Adjustments (paragraph 5-23) FM Distortion Adjustment (paragraph 5-24) FM Deviation Adjustment (paragraph 5-25)
A3 Assembly (Shaping Amplifier only)	Output Level Accuracy Test (paragraph 4-17) AM Sensitivity and Indicated Accuracy Test (paragraph 4-22) AM Distortion Test (paragraph 4-23)	Detector Bias and AM Distortion Adjustment (paragraph 5-18) Meter Adjustments (paragraph 5-20)
A3 Assembly (Audio Detector and Meter Driver only)	AM Sensitivity and Indicated Accuracy Test (paragraph 4-22)	Meter Adjustments (paragraph 5-20)
A5 FM Driver Board Assembly (see note)	FM Distortion Test (paragraph 4-25) FM Sensitivity and Meter Accuracy Test (paragraph 4-26)	Preliminary FM Adjustments (paragraph 5-23) FM Distortion Adjustment (paragraph 5-24) FM Deviation Adjustment (paragraph 5-25)
A6A1 Reverse Power Protection Board Assembly (Option 003 only)	—	Output Impedance Adjustment (Option 003 only, paragraph 5-26) Reverse Power Level Sense Adjustment (Option 003 only, paragraph 5-27)
M1 Meter	AM Sensitivity and Indicated Accuracy Test (paragraph 4-22)	Meter Adjustments (paragraph 5-20)

NOTE

Repairs to these assemblies may require FM adjustments. FM adjustments are complex, time consuming, and require special test equipment.

ADJUSTMENTS

5-17. POWER SUPPLY ADJUSTMENT

REFERENCE: Service Sheet 7.

DESCRIPTION: A dc voltmeter is used to monitor the +20V supply voltage as it is adjusted.

EQUIPMENT: Digital Multimeter . . . . . HP 34702A/34740A

PROCEDURE:

1. Set Signal Generator LINE switch to ON. Connect voltmeter to A3TP7. Adjust +20V Adjust control A3R5 for voltmeter reading of +20.0 ±0.2 Vdc.

2. Connect DVM to A3TP6. The voltage should read −10.0 ± 0.5 Vdc.

5-18. DETECTOR BIAS AND AM DISTORTION ADJUSTMENT

REFERENCE: Service Sheets 3 and 4.

DESCRIPTION: The RF Detector Bias is adjusted so the RF output voltage tracks the ALC dc reference voltage which is set by the VERNIER control. The Distortion Null is adjusted so the RF envelope accurately represents the audio AM drive signal at low ALC reference levels. Since the two adjustments interact, the adjustments may need to be repeated. A spectrum analyzer is used to measure the RF output level and detect the AM signal. The ALC reference is monitored with a dc voltmeter.

EQUIPMENT:
Spectrum Analyzer . . . . . HP 8558B/182C
Digital Multimeter . . . . . HP 34702A/34740A
10 dB Step Attenuator . . . . . HP 355D

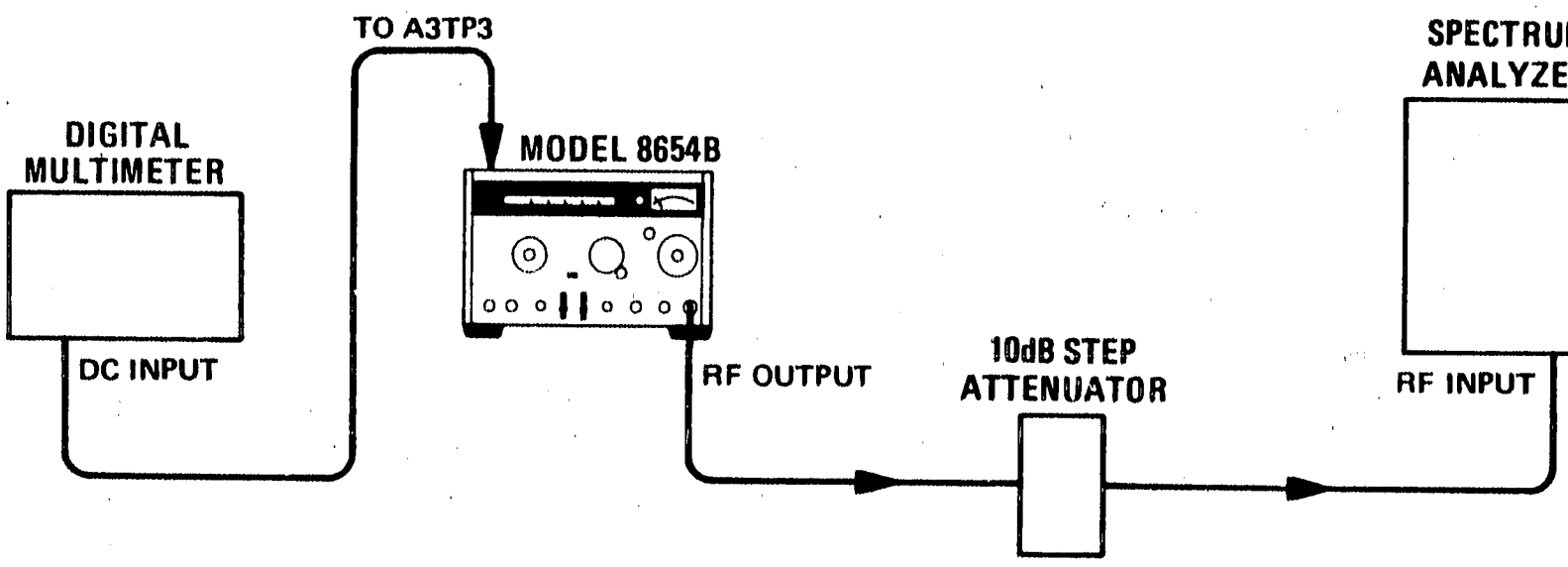


Figure 5-1. Detector Bias and AM Distortion Adjustment Setup

PROCEDURE:

1. If A1 RF Section Assembly cover has not been removed, remove detector bias access plug on bottom side of assembly.

2. Center Detector Bias potentiometer A1A1R39 (Service Sheet 3) and Distortion Adjust potentiometer A3R52 (Service Sheet 4).

ADJUSTMENTS

5-18. DETECTOR BIAS AND AM DISTORTION ADJUSTMENT (Cont'd)

3. Connect equipment as shown in Figure 5-1 after setting Signal Generator controls as follows:

METER	LEVEL
FREQUENCY RANGE (MHz)	35—66 MHz
FREQUENCY TUNE	50 MHz
OUTPUT LEVEL Switch	+10 dBm
AM	INTERNAL
AM LEVEL	Fully ccw
FM	OFF
400 Hz/1 kHz Switch	400 Hz

4. Set step attenuator to 20 dB.

5. Set Signal Generator output level VERNIER for voltmeter reading of —2.00 Vdc at A3TP3.

6. Set spectrum analyzer resolution bandwidth to 300 kHz or greater, optimum input level to 0 dBm (40 dB attenuation), vertical scale to linear, display smoothing to between 10 and 50 kHz, and adjust frequency controls to center 50 MHz signal on display. Set frequency span to 0 and fine adjust frequency controls to peak signal on display. Adjust vertical reference level controls to bring signal to fifth graticule line from bottom of display.

NOTE

Check spectrum analyzer baseline position by removing RF input. Baseline should be exactly on bottom graticule line.

7. Set Signal Generator OUTPUT LEVEL switch to 0 dBm, and adjust VERNIER for voltmeter reading of —0.20 Vdc.

8. Set step attenuator to 0 dB. Use non-metallic tool to adjust Detector Bias control A1A1R39 to bring signal to same reference level (fifth line from bottom).

9. Repeat steps 4 to 8 until RF signal level viewed on the spectrum analyzer is same for both —2.00 Vdc and —0.20 Vdc ALC reference levels.

10. Set —0.20 Vdc at A3TP3 and adjust AM LEVEL control so that upper peak of sine wave is at eighth graticule line from bottom of display (set analyzer to trigger internally).

11. Adjust Distortion Adjust control A3R52 so that lower peak of sine wave is at second graticule line.

12. Set AM LEVEL fully ccw. If level has shifted more than 0.2 division from fifth graticule line, set OUTPUT LEVEL to +10 dBm and repeat steps 4 to 12.

13. Perform AM Sensitivity Adjustment (paragraph 5-19), AM Sensitivity and Indicated Accuracy Test (paragraph 4-22), and AM Distortion Test (paragraph 4-23).

ADJUSTMENTS

5-19. AM SENSITIVITY ADJUSTMENT

REFERENCE: Service Sheet 4.

DESCRIPTION: The Signal Generator is externally amplitude modulated by a test oscillator with a level set to give 60% AM. The AM is demodulated with a spectrum analyzer in a zero span mode. The AM depth is measured directly on the display and is compared with the panel meter reading.

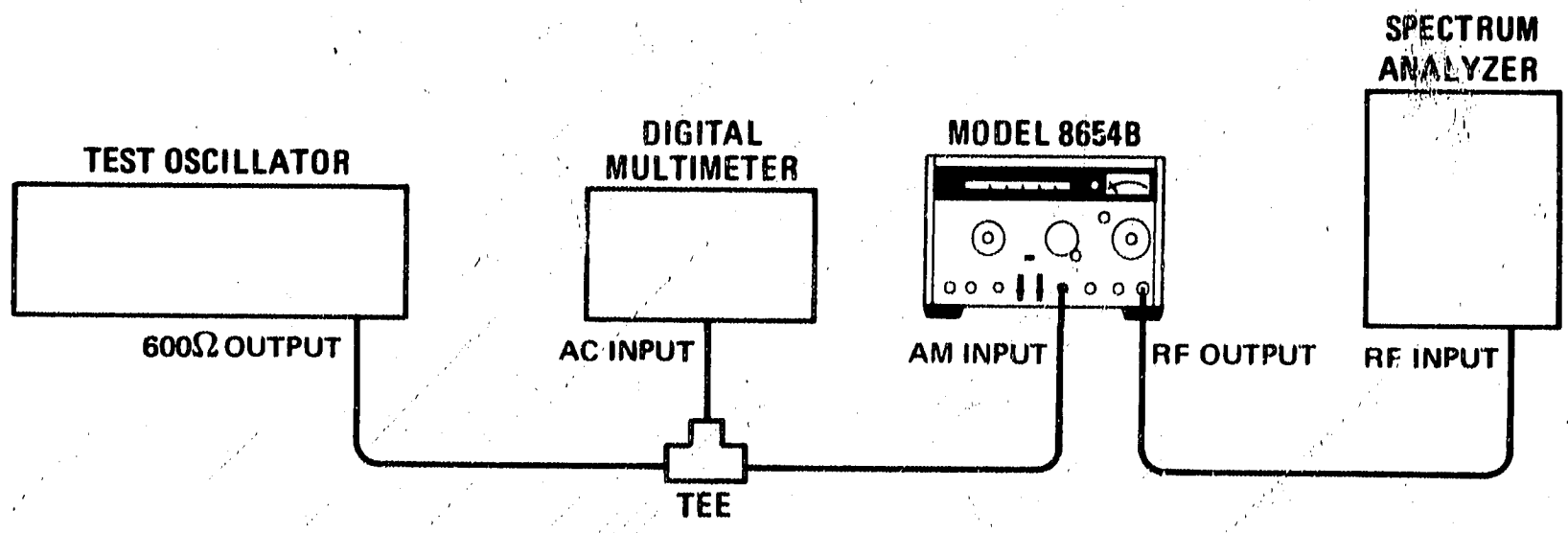


Figure 5-2. AM Sensitivity Adjustment Setup

EQUIPMENT:

Spectrum Analyzer	HP 8558B/182C
Test Oscillator	HP 651B
Digital Multimeter	HP 34702A/34740A

PROCEDURE:

1. Connect equipment as shown in Figure 5-2, after setting Signal Generator controls as follows:

METER	LEVEL
FREQUENCY RANGE (MHz)	35—66 MHz
FREQUENCY TUNE	50 MHz
OUTPUT LEVEL Switch	—40 dBm
Output Level VERNIER	Meter reads +3 dB
AM	EXT
AM LEVEL	Fully cw
FM	OFF

2. Set spectrum analyzer resolution bandwidth to 300 kHz or greater, optimum input level to —40 dBm (0 dB attenuation), vertical scale to linear, display smoothing to between 10 and 50 kHz, and adjust center frequency controls to center 50 MHz signal on display. Adjust vertical reference level controls to bring signal level to fifth graticule line from bottom of display.

3. Set test oscillator to 1 kHz and adjust level for 0.424 Vrms (0.6 Vpk) as read on ac voltmeter.

4. Adjust AM Gain potentiometer A3R34 for peak-to-peak deflection of 6 divisions on display (corresponding to 60% AM).

NOTE

Check spectrum analyzer base line position by removing RF input. Base line should be exactly on bottom graticule line.

ADJUSTMENTS

5-20. METER ADJUSTMENTS

REFERENCE: Service Sheet 4.

DESCRIPTION: The meter is set mechanically to zero. Then the meter amplifier gain and zero controls are adjusted so the meter tracks the actual RF output as monitored with a power meter. Finally, the audio detector gain is adjusted.

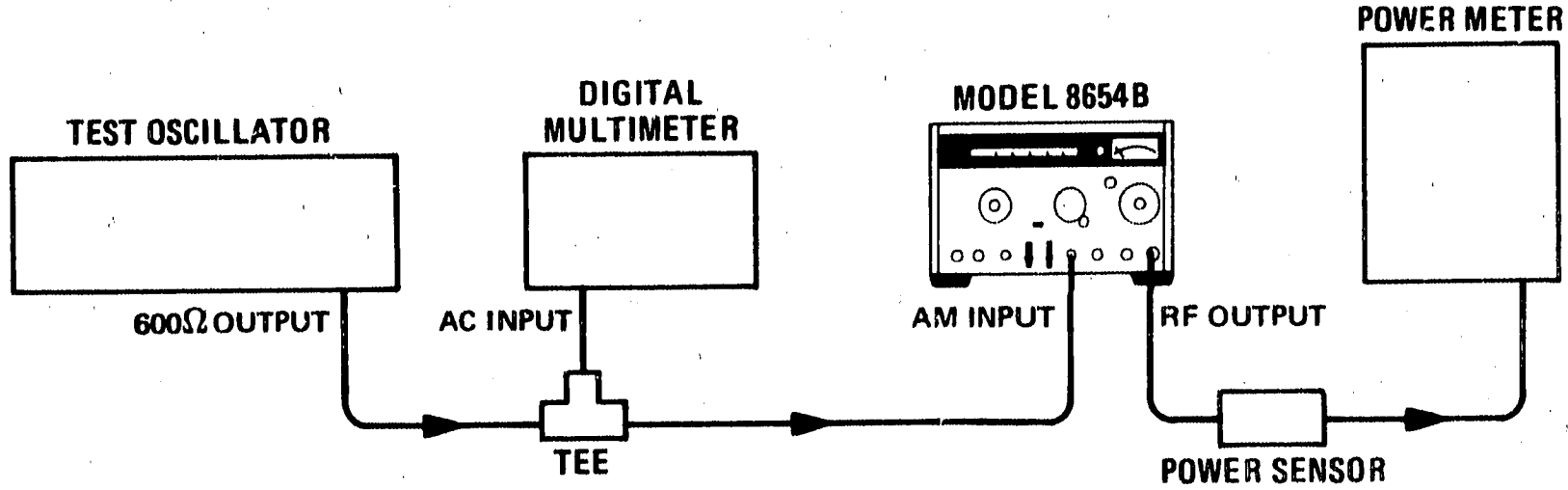


Figure 5-3. Meter Adjustments Setup

EQUIPMENT:

Power Meter and Sensor	HP 435A/8481A
Digital Multimeter	HP 34702A/34740A
Test Oscillator	HP 651B

PROCEDURE:

1. Set Signal Generator LINE switch to OFF. Allow time for meter to fall to rest. Adjust mechanical zero adjustment screw on panel meter cw for a zero meter reading. Then turn screw slightly ccw to free mechanism from adjusting peg.

2. Set LINE switch to ON. Connect equipment as shown in Figure 5-3 after setting Signal Generator controls as follows:

METER	LEVEL
FREQUENCY RANGE (MHz)	35–66 MHz
FREQUENCY TUNE	50 MHz
OUTPUT LEVEL Switch	+10 dBm
Output Level VERNIER	Fully ccw
AM	OFF
AM LEVEL	Fully cw
FM	OFF

3. Allow at least a 5-minute warmup. Set power meter range to measure +10 dBm.

4. Adjust output level VERNIER for power meter reading of +10 dBm (+8 dBm for Option 003). Adjust Meter Gain control A3R57 for 0 dB (−2 dB for Option 003) as read on Signal Generator panel meter.

5. Set OUTPUT LEVEL switch to 0 dBm and adjust VERNIER for power meter reading of −7 dBm. Adjust Meter Zero control A3R54 for −7 dB as read on panel meter.

ADJUSTMENTS

5-20. METER ADJUSTMENTS (Cont'd)

6. Adjust output level VERNIER for power meter reading 0 dBm. If panel meter does not read within ±0.2 dB of 0 dBm, slightly readjust Meter Gain A3R57 for proper reading.

7. Repeat steps 4 to 6, adjusting Meter Gain A3R57 and Meter Zero A3R54 as needed until panel meter reads within ±0.2 dB of power meter reading for levels of +10, (+8 for Option 003), 0, and −7 dBm.

NOTE

If it is not possible to attain meter readings within ±0.2 dB of power meter reading for levels of +10 (+8 for Option 003) and 0 dBm, select a different value of resistance for A3R53 (1330—1470Ω). Decreasing resistance increases the meter indication at 0 dBm but does not directly affect the +10 dBm range.

8. Set OUTPUT LEVEL to approximately 0 dBm, AM to EXT (with AM LEVEL fully cw), and METER to AM.

9. Set test oscillator for 1 kHz and adjust level for 0.707 Vrms as read on ac voltmeter.

10. Adjust Detector Gain control A3R45 for panel meter reading of 10.

NOTE

Check that Meter jumper (connected to A3C27) is in N (normal) position.

5-21. TUNING CAPACITOR PULLEY ADJUSTMENT

REFERENCE: Service Sheet 2.

DESCRIPTION: The position of the capacitor pulley on the capacitor shaft is set for the full tuning range of the capacitor as the frequency is tuned from stop to stop. The pulley is correctly adjusted when the frequency can be tuned through minimum at the low frequency end of the dial and through the maximum at the high end (refer to Figure 5-4).

NOTE

Performing the Tuning Capacitor Pulley Adjustment will require that FM adjustments also be performed. FM adjustments are complex, time consuming, and require special test equipment.

EQUIPMENT:

Frequency Counter	HP 5383A

PROCEDURE:

1. Remove the RF Section Assembly cover as described on Service Sheet A.

2. Connect the counter's high frequency low impedance input to RF Amplifier output connector A1A1J3. Set Signal Generator controls as follows:

FREQUENCY RANGE (MHz)	10—19 MHz
FREQUENCY TUNE	Fully ccw to stop

ADJUSTMENTS

5-21. TUNING CAPACITOR PULLEY ADJUSTMENT (Cont'd)

OUTPUT LEVEL Switch . . . . 0 dBm
Output Level VERNIER . . . . . Fully cw
AM . . . . . OFF
FM . . . . . OFF

3. Check that the FREQUENCY TUNE control is against the counterclockwise (low frequency) stop.

4. Loosen the two setscrews on the capacitor pulley.

5. Insert a non-metallic tuning tool into the slotted end of the tuning cap acitor shaft (C3) and adjust the low frequency foldback as read on the counter, from 5 to 10 kHz beyond the frequency minimum. The frequency will be approximately 9.5 MHz and the capacitor blades will be almost fully meshed (refer to Figure 5-4).

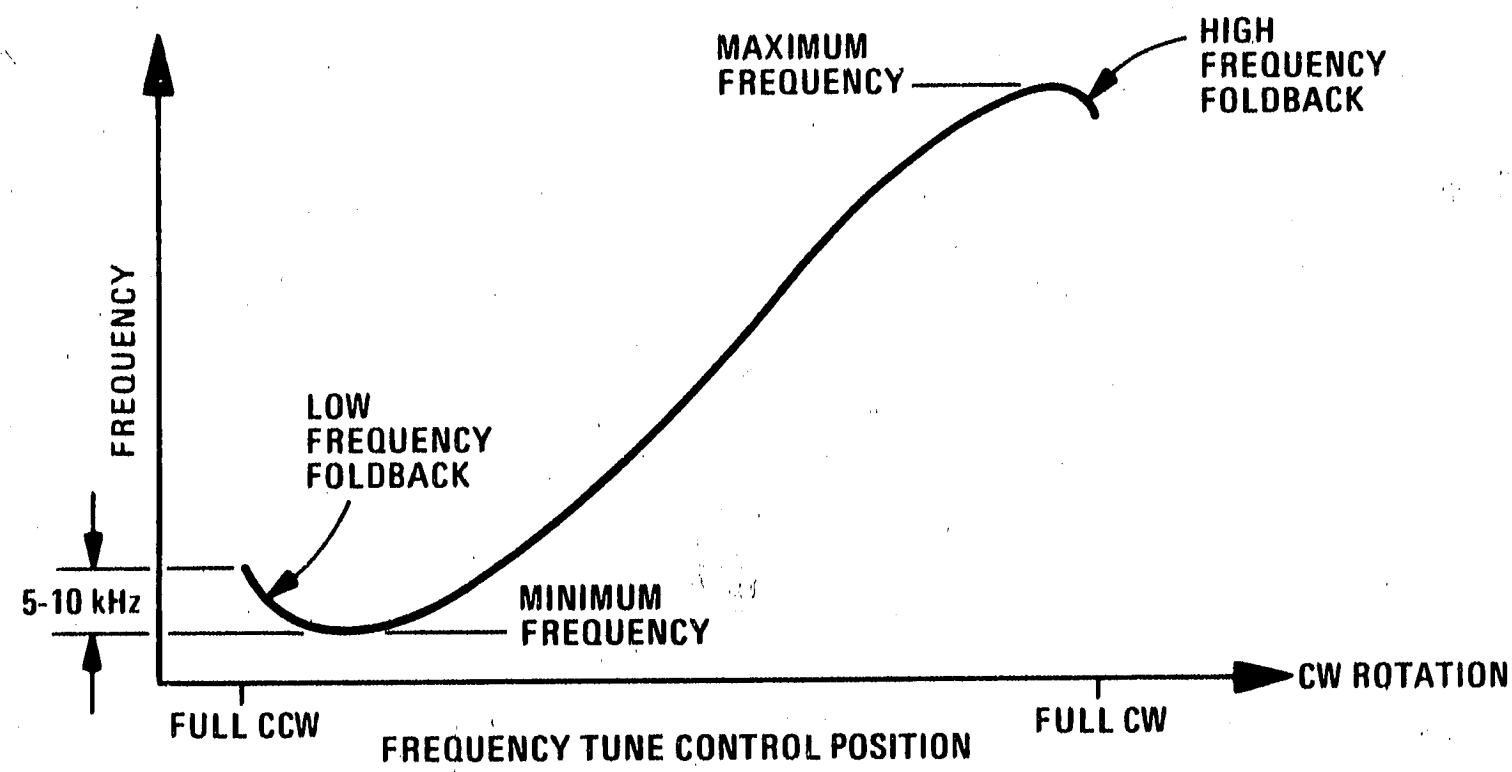


Figure 5-4. Proper Capacitor Tuning Characteristics

6. Tighten the pulley setscrews.

CAUTION

Verify that the pulley does not rub against the oscillator cables or chassis parts, and that the dial cord does not rub against the casting as it passes through the holes.

7. Tune the frequency up a few turns and then back to the counterclockwise stop. Check that the frequency tunes from 5 to 10 kHz beyond the minimum.

NOTE

Some frequency foldback is also normal at the high end of the frequency range.

8. Perform the Frequency Range Adjustment (paragraph 5-22), Preliminary FM Adjustments (paragraph 5-23), FM Distortion Adjustment (paragraph 5-24), and FM Deviation Adjustment (paragraph 5-25).

ADJUSTMENTS

5-22. FREQUENCY AND RANGE ADJUSTMENT

REFERENCE: Service Sheets 2 and 3.

DESCRIPTION: The cover of the RF Section Assembly is removed and both the range inductors and the tuning range capacitor are adjusted.

NOTE

Performing the Frequency and Range Adjustment will require that the FM adjustments also be performed. FM adjustments are complex, time consuming, and require special test equipment.

EQUIPMENT:

Frequency Counter	HP 5383A
Power Meter	HP 435A/8481A

PROCEDURE:

NOTE

Before performing this adjustment, check the bias voltages on the FM Modulator varactor diodes. With RANGE set to 270—520 MHz, the voltage at A5TP8 (Service Sheet 6) should be 0.0 ± 0.1 Vdc. The voltage at J2 pin 4 (Service Sheet 6) should be +48.5 ±1.0 Vdc.

1. Remove the RF Section Assembly and RF Section Assembly cover as described on Service Sheets A and B.

NOTE

If adjustment is necessary only to correct a consistent cursor position error (indication consistently high or low on all ranges), the dial drum may be moved slightly to the right or left after loosening the dial drum setscrew. Do not allow dial drum to bind against the base plate casting. This adjustment does not require FM recalibration.

2. Connect the counter's high frequency, low impedance input to RF Amplifier output connector A1A1J3. Set Signal Generator's controls as follows:

FREQUENCY RANGE (MHz)	270—520 MHz
FREQUENCY TUNE	270 MHz
OUTPUT LEVEL Switch	0 dBm
Output Level VERNIER	Fully cw
AM	OFF
FM	OFF

3. Adjust the 270—520 MHz turret inductor A1A4L6 for a counter reading of 270 ±2.7 MHz.

CAUTION

To prevent damage to the +14 Vdc power supply, set LINE to OFF before making these adjustments.

ADJUSTMENTS

5-22. FREQUENCY AND RANGE ADJUSTMENT (Cont'd)

NOTE

To increase frequency, add equal amounts of solder to two slots in the inductor strip. To lower frequency bend the inductor tab.

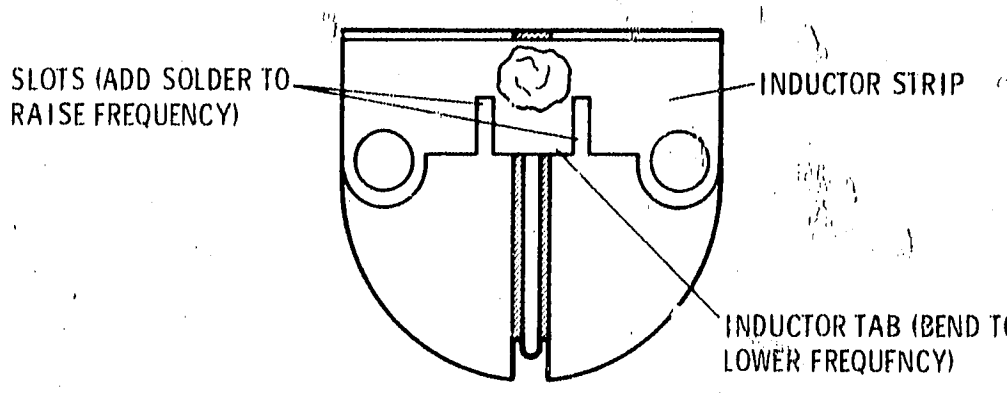


Figure 5-5. A1A4L6 Turret Inductor Adjustment (270–520 MHz Range)

4. Set FREQUENCY TUNE to 520 MHz and adjust Tuning Range capacitor A1A3C2 for a reading of 520 ± 5.2 MHz.

NOTE

If 520 MHz is not attainable, see the selection procedure for capacitor A1A3C12 in Table 5-1.

5. Check at least four FREQUENCY TUNE settings on the range to ensure ±2% accuracy for each setting.

6. Set FREQUENCY TUNE to any convenient location on each of the other five ranges. Adjust the turret inductors for counter readings within 2% of the dial indication.

CAUTION

To prevent damage to the +14 Vdc power supply, set LINE to OFF before making adjustments to the 130—270 MHz range inductor.

NOTE

On the 130—270 MHz range, the inductor is adjusted by spreading or pinching the inductor loops. On the 10—130 MHz ranges adjustment is accomplished with a tuning slug in the inductor.

7. Check at least four FREQUENCY TUNE settings on each range to ensure ±2% accuracy for each setting. Readjust the turret inductors as necessary to attain this overall accuracy.

ADJUSTMENTS

5-22. FREQUENCY AND RANGE ADJUSTMENT (Cont'd)

8. Connect the power meter's sensor to RF Oscillator output connector A1A3J1. Output power should be greater than +3 dBm at all FREQUENCY RANGE (MHz) and FREQUENCY TUNE settings.

9. Replace RF Section Assembly cover and install the RF Section Assembly in the instrument.

10. Perform the Preliminary FM Adjustments (paragraph 5-23), FM Distortion Adjustment (paragraph 5-24), and FM Deviation Adjustment (paragraph 5-25).

5-23. PRELIMINARY FM ADJUSTMENTS

REFERENCE: Service Sheets 5, 6, and 7.

DESCRIPTION: Various dc voltages and voltage nulls on the A5 FM Driver Assembly are adjusted.

EQUIPMENT:

Digital Multimeter	HP 34702A/34740A
Frequency Counter	HP 5383A

PROCEDURE:

1. Remove instrument top cover.

2. Connect a jumper wire between A5TP8 (Service Sheet 6) and A5TP12, GND, (Service Sheet 7).

3. Connect frequency counter to rear panel AUX RF OUT after setting Signal Generator controls as follows:

FREQUENCY RANGE (MHz)	19—35 MHz
FREQUENCY TUNE	35 MHz
FINE TUNE	centered
AM	OFF
FM	OFF
FM RANGE (kHz)	30 kHz

4. Connect dc voltmeter to A5TP3 (Service Sheet 5). Use testpoint A5TP12 (Service Sheet 7) as common ground for all preliminary adjustments. Set FREQUENCY TUNE for 35.0 MHz as read on counter.

5. Adjust ADJ A A5R16 (Service Sheet 5) for voltmeter reading of +10.00 Vdc.

6. Set FREQUENCY TUNE for 19.0 MHz as read on counter.

7. Adjust ADJ B A5R18 (Service Sheet 5) for voltmeter reading of +5.40 Vdc.

8. Repeat steps 3 through 6 until voltages are within ± 0.10 Vdc of those specified at 19.0 and 35.0 MHz.

9. Connect dc voltmeter to A5TP5 (Service Sheet 5). Set FREQUENCY TUNE for 25.0 MHz as read on counter.

ADJUSTMENTS

5-23. PRELIMINARY FM ADJUSTMENTS (Cont'd)

11. Adjust ADJ C A5R42 (Service Sheet 5) for voltmeter reading of 0.60 ± 0.20 Vdc.

12. Connect dc voltmeter to A5TP6 (Service Sheet 6).

13. Adjust ADJ F A5R122 (Service Sheet 6) for 0.00 ± 0.20 Vdc.

14. Connect dc voltmeter to A5TP8 (Service Sheet 6).

15. Connect a jumper wire between A5TP10 (Service Sheet 6) and ground (A5TP12).

16. Adjust ADJ E A5R63 (Service Sheet 6) so that voltage at A5TP8 remains constant within ± 0.20V as frequency is tuned between 19 and 35 MHz.

NOTE

The voltage will be approximately 0 Vdc but need not be exactly 0 Vdc; however, it must be constant as the frequency is tuned.

17. Remove jumper wire between A5TP10 and TP12. Connect jumper wire between A5TP8 and ground (A5TP12).

18. Connect dc voltmeter to A5TP10.

19. Adjust ADJ D A5R104 (Service Sheet 6) for voltmeter reading of 0.0 ± 0.1 mVdc.

20. Remove jumper wire between A5TP8 and TP12.

21. Connect dc voltmeter to A5TP5. Set FREQUENCY TUNE to 25.0 MHz (on frequency counter).

22. Adjust ADJ C A5R42 for a voltmeter reading of 0.60 ± 0.01 Vdc.

23. Perform FM Distortion Adjustment (paragraph 5-24) and FM Deviation Adjustment (paragraph 5-25).

5-24. FM DISTORTION ADJUSTMENT

REFERENCE: Service Sheet 6.

DESCRIPTION: The Signal Generator is frequency modulated internally at a 1 kHz rate. The FM signal is demodulated by a frequency meter. The deviation level is measured at the discriminator output, and set to 30.0 kHz. The distortion is then measured and adjusted to be minimum. A reference generator and a mixer convert the RF output of the test Signal Generator to within the range of the frequency meter. A low-pass filter at the mixer output prevents the frequency meter from mis-triggering on the upper sideband generated by the mixer when the RF is low in frequency.

ADJUSTMENTS

5-24. FM DISTORTION ADJUSTMENT (Cont'd)

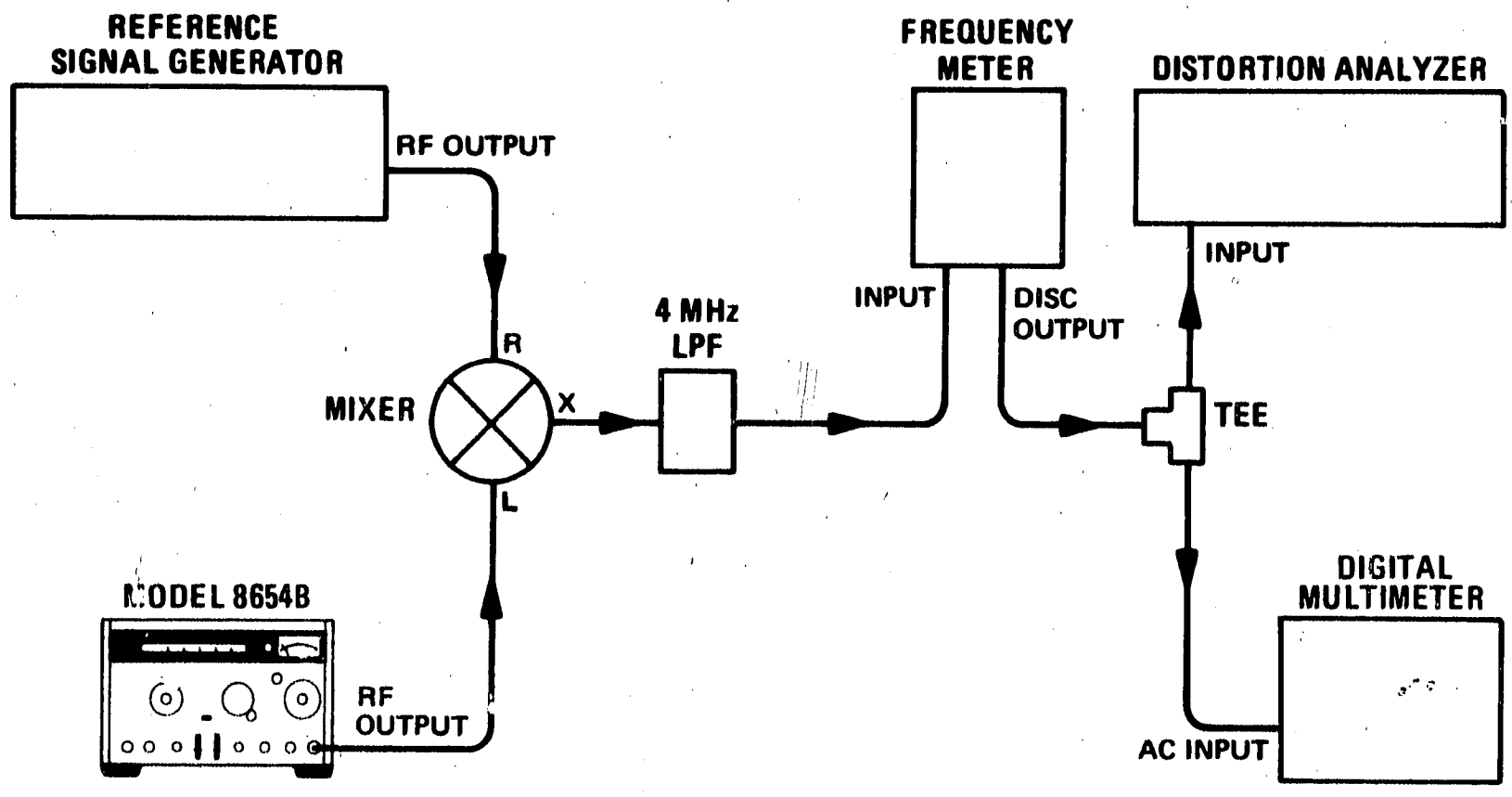


Figure 5-6. FM Distortion Adjustment Setup

EQUIPMENT:

Frequency Meter	HP 5210A
Filter Kit (for Frequency Meter)	HP 10531A
Distortion Analyzer	HP 331A
Signal Generator (reference)	HP 8640A
Digital Multimeter	HP 34702A/34740A
Mixer	HP 10514A
4 MHz Low pass Filter	CIR-Q-TEL 3 Pole

PROCEDURE:

1. Install shorting board in frequency meter and calibrate it for 1 Vdc at output jack for a full-scale meter reading. Remove shorting board and install a 10 kHz Butterworth low-pass filter.

2. Connect equipment as shown in Figure 5-6 after setting test Signal Generator controls as follows:

METER:	LEVEL
FREQUENCY RANGE (MHz)	10—19 MHz
FREQUENCY TUNE	10 MHz
OUTPUT LEVEL Switch	+10 dBm
Output Level VERNIER	Meter reads —3 dB
AM	OFF
FM	INT
FM RANGE (kHz)	30 kHz
FM LEVEL	Fully ccw
400 Hz/1 kHz	1 kHz

ADJUSTMENTS

5-24. FM DISTORTION ADJUSTMENT (Cont'd)

3. Set reference signal generator for a −7 dBm signal at 11 MHz.

4. Set frequency meter to trigger on input signal; set frequency range to 1 MHz. Fine tune reference signal generator for an on-scale frequency meter reading of approximately 0.8 MHz.

5. Set METER switch to FM. Adjust FM LEVEL of test Signal Generator for a voltmeter reading of 21.2 mVrms (or 30.0 mVpk which corresponds to 30.0 kHz frequency deviation).

6. Calibrate distortion analyzer for 1 kHz signal and measure distortion. Adjust DIST potentiometer A5R107 for minimum distortion.

7. Recheck voltmeter reading. If it changed significantly, reset FM LEVEL for a voltmeter reading of 21.2 mVdc and readjust A5R107 for minimum distortion. Distortion should be less than 1.5%.

8. Repeat steps 2 through 7 at 35 MHz (35—66 MHz range). Tune reference signal generator to 36 MHz at −7 dBm.

9. Minimum distortion for 35 MHz might occur at a slightly different adjustment than at 10 MHz. Note where A5R107 is set for both frequencies and set it midway between those positions. Distortion must be less than 1.5% for both frequencies.

NOTES

The set level on the distortion analyzer must be set to a lower range because of the low level of the discriminator output. This lower level becomes the 100% level.

If distortion is excessive, check discriminator output with an oscilloscope. If the signal is clipped, reduce FM LEVEL slightly until clipping ceases; adjust DIST potentiometer A5R107 for minimum distortion; then repeat with proper FM LEVEL.

If a frequency meter filter greater than 10 kHz is used, the noise in the system may contribute to the level of distortion read on the meter.

10. Perform FM Deviation Adjustment (paragraph 5-25).

ADJUSTMENTS

5-25. FM DEVIATION ADJUSTMENT

REFERENCE: Service Sheets 5 and 6.

DESCRIPTION: The following procedure calibrates the FM deviation for each frequency range. This is done by selecting resistors that set the breakpoint, slope, exponent, and gain of the FM driving circuits. (These are parameters that affect the FM deviation vs. frequency tuning and range.) The FM meter and deviation ranges are also calibrated.

A special test accessory (HP 08654-60084 FM Deviation Adjustment Board) is required. It has a built-in square wave generator and a set of switches and potentiometers which substitute for the resistors to be selected during the calibration. After calibration of a given frequency range, the potentiometers are switched to an ohmmeter for ease of measurement. Also required is a frequency counter with frequency difference measurement capability (HP Model 5345A/5354A or 5345A/5353A; see note below). The counter permits rapid characterization of deviation vs. carrier frequency without having to be tuned.

The adjustment is made by frequency modulating the generator with an accurate ±0.949V square wave. The frequency of the generator is measured during each half of the square wave cycle and the difference between the two frequencies is displayed. This is the peak-to-peak FM deviation. Each half cycle of the square wave is triggered by the counter gate which also allows adequate time for the square wave to settle before initiating the count.

With the test accessory controls at the initial settings, the FM deviation for a typical frequency range is as shown in Figure 5-7. First the generator is tuned to a nominal midrange frequency. The FM gain is then adjusted for 60 kHz peak-to-peak deviation (30 kHz peak) as in Figure 5-7b. The generator is then tuned to the maximum nominal frequency on the range and the FM exponent is adjusted for a deviation of 60 kHz peak-to-peak as in Figure 5-7c.

Now the generator is tuned down in frequency until the deviation begins to increase and the FM breakpoint is adjusted to bring the deviation back to 60 kHz peak-to-peak. This, however, is done with maximum correction or FM slope and the result is as in Figure 5-7d. The generator is then tuned to the minimum nominal frequency and the FM slope is adjusted for 60 kHz peak-to-peak deviation.

Figure 5-7e shows a properly adjusted generator. The frequency range should be carefully checked for constant deviation. Figure 5-7f shows the deviation response of a range with an improper breakpoint adjustment.

The 270—520 MHz FREQUENCY RANGE has two FM breakpoint and slope adjustments. The adjustment of this range, however, follows the same principles as for the other ranges. Finally, the FM gain for the 3, 10, and 100 kHz deviation ranges is adjusted.

To aid in visualizing FM deviation flatness, throughout theis procedure, plot counter readings on the graphs in Figure 5-9.

Before performing this adjustment, perform Preliminary FM Adjustments (paragraph 5-23) and FM Distortion Adjustment (paragraph 5-24).

NOTE

Paragraph 5-25A gives a procedure for using an HP-IB programmable counter and digital-to-analog converter in place of the HP 5345A.

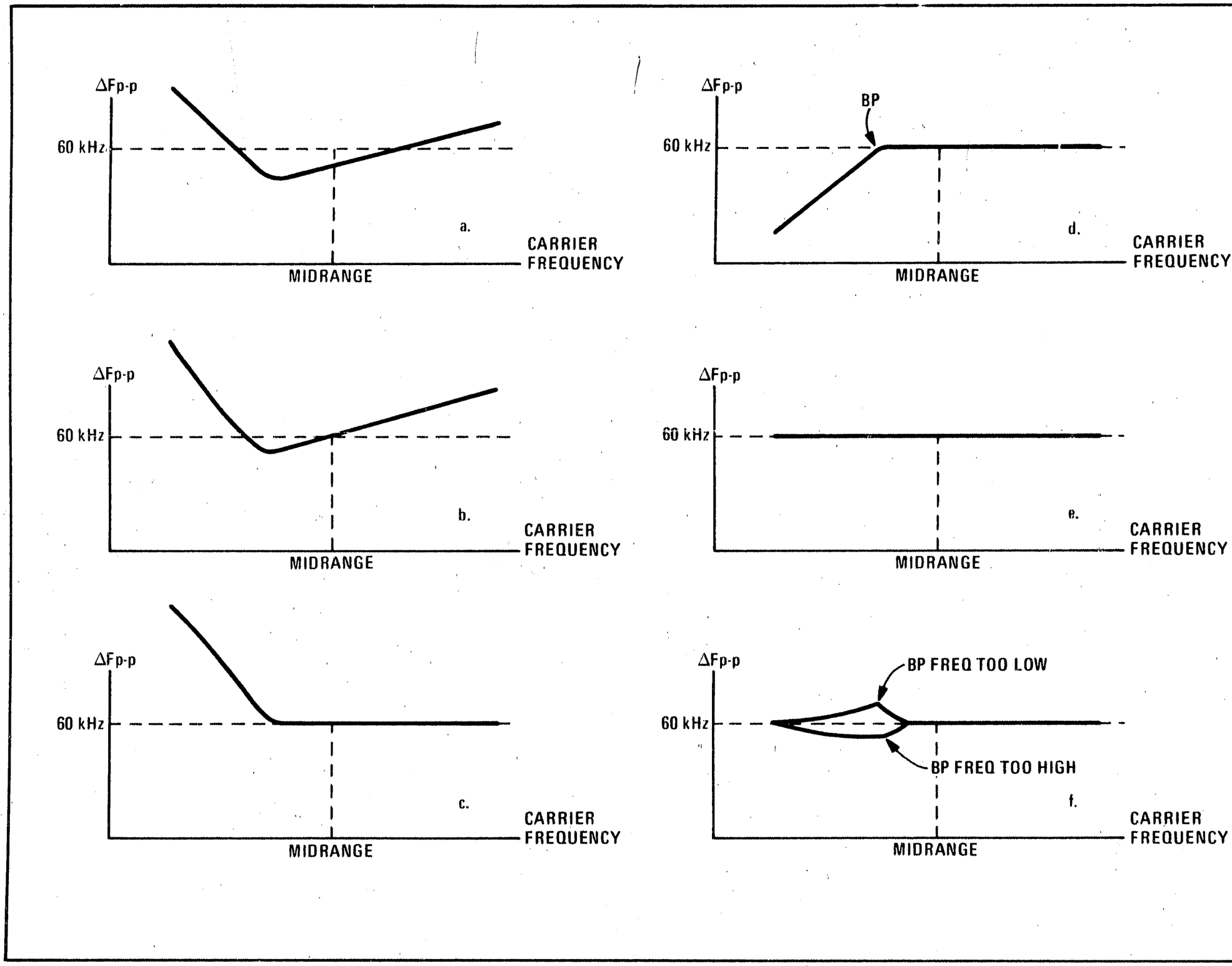


Figure 5-7. FM Deviation vs. Carrier Frequency for Various Stages of FM Deviation Calibration

ADJUSTMENTS

5-25. FM DEVIATION ADJUSTMENT (cont'd)

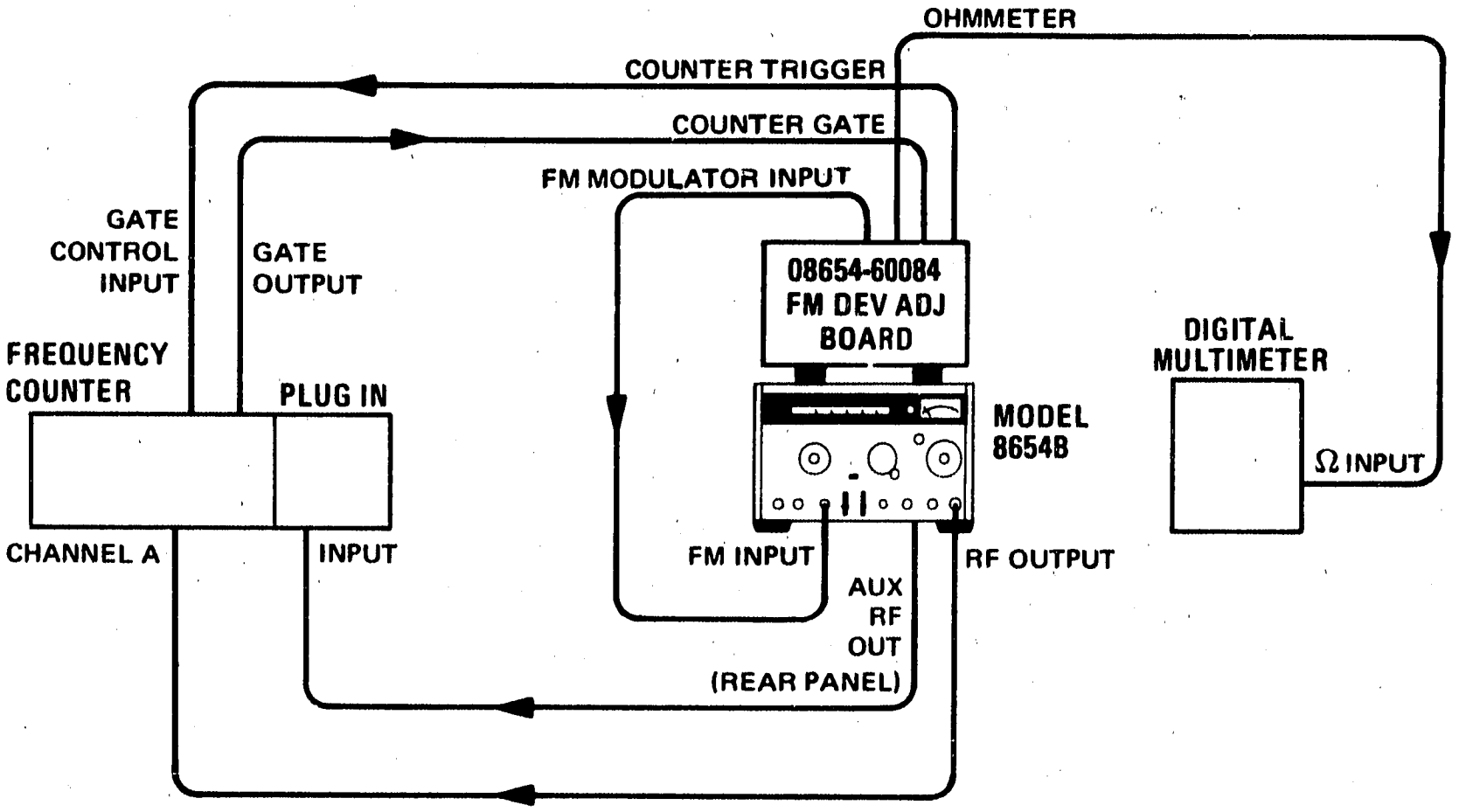


Figure 5-8. FM Deviation Adjustment Setup

EQUIPMENT:

Frequency Counter	HP 5345A/5354A
Digital Multimeter	HP 34702A/34740A
FM Deviation Adjustment Board . . .	HP 08654-60084

PROCEDURE:

NOTE

Due to the complex nature of this adjustment, it is extremely important that you read and understand the information presented under DESCRIPTION.

Initial Setup

1. Remove instrument top cover.
2. Mount FM Deviation Adjustment Board to rear panel (use two screws from top cover).
3. Interconnect instruments as shown in Figure 5-8.
4. Remove two ribbon cables from A5 FM Driver Board Assembly and connect to corresponding connector jacks J1 and J2 on Adjustment Board. Connect three ribbon cables from Adjustment Board to corresponding connector jacks A5J1, J2, and J3 on A5 FM Driver Board Assembly.

ADJUSTMENTS

5-25. FM DEVIATION ADJUSTMENT (Cont'd)

5. Set Signal Generator controls as follows:

METER	LEVEL
FREQUENCY RANGE (MHz)	19—35 MHz
FREQUENCY TUNE	19 MHz
FINE TUNE	Centered
OUTPUT LEVEL Switch	0 dBm
Output Level VERNIER	Meter reads +3 dB
AM	OFF
FM	EXT
FM RANGE	30 kHz
FM LEVEL	Fully cw

6. Set Adjustment Board controls as follows:

BP Switch	Down
SL Switch	Down
E Switch	Down
G Switch	Down
BP7 Switch	Down
SL7 Switch	Down
BP Potentiometer	Fully cw
SL Potentiometer	Fully cw
E Potentiometer	Fully ccw
G Potentiometer	Fully ccw
BP7 Potentiometer	Fully cw
SL7 Potentiometer	Fully cw

7. Set frequency counter controls as follows:

FUNCTION		FREQ A
GATE TIME		10 ms
DISPLAY POSITION		AUTO
CHANNEL A	LEVEL	PRESET
	Impedance	50Ω
	ATTEN	x1
	Mode	SEP
PLUG IN		AUTO; CONT. WAVE
GATE CONTROL INPUT (rear panel)		EXT ARM

NOTES

The Adjustment Board must have been preadjusted to give a ±0.949 ±0.003V square wave at the Signal Generator FM INPUT. If it does not, disconnect the input to the counter gate and check the FM drive (out of the coaxial cable) with a dc voltmeter. The toggle switch can be used to reverse the level of the drive voltage. See Service Note P-08654-60084.

In the following procedure the counter reads the peak-to-peak FM deviation. The peak deviation (indicated on generator's panel meter) is one-half of this reading.

ADJUSTMENTS

5-25. FM DEVIATION ADJUSTMENT (Cont'd)

19–35 MHz Range Adjustment

8. Set METER to FM. Tune FREQUENCY TUNE between 19 and 35 MHz stopping at each turn of the knob to check counter. Counter should read 60.0 ±3.6 kHz for all frequencies.

9. If frequency deviation was correct, proceed to step 25.

10. If frequency deviation was uniformly too high or low, adjust GAIN A5R59 (Service Sheet 6) and check that frequency deviation is 60.0 ± 3.6 kHz across range. Proceed to step 25.

11. If frequency deviation was incorrect, unsolder and lift one end of resistors A5R4 (2B), R23 (2S), and R44 (2E) shown on Service Sheet 5.

12. Set BP, SL, and E switches on Adjustment Board up.

13. Tune frequency to 25 MHz. Adjust GAIN A5R59 for counter reading of 60.0 ± 0.2 kHz.

14. Tune frequency to 35 MHz. Adjust E potentiometer on Adjustment Board for counter reading of 60.0 ± 0.6 kHz.

15. Tune back to 25 MHz stopping at each turn of knob to check counter. To aid in visualizing deviation flatness, plot counter readings on Figure 5-9. Counter should read 60.0 ± 3.6 kHz for these frequencies.

16. If frequency deviation was incorrect, readjust GAIN A5R59 and E on Adjustment Board for best compromise.

17. Tune down in frequency below 25 MHz until deviation increases 1 kHz above deviation at 25 MHz. Adjust BP potentiometer on Adjustment Board for counter reading of 60.0 ± 0.2 kHz.

18. Tune frequency to 19 MHz. Adjust SL potentiometer on Adjustment Board for counter reading of 60.0 ± 0.6 kHz.

19. Tune back to 25 MHz stopping at each turn of knob to check counter. If desired, plot counter readings on Figure 5-9. Counter should read 60.0 ± 3.6 kHz for these frequencies.

20. If frequency deviation was incorrect, readjust BP and SL on Adjustment Board for best compromise.

21. Recheck deviation from 19 to 35 MHz. If deviation is not 60.0 ± 3.6 kHz, readjust GAIN A5R59 and BP, SL, and E on Adjustment Board for best compromise.

22. Set G, BP7, and SL7 switches up. Measure resistance of BP, SL, and E potentiometers by setting each corresponding switch down. Note resistance on Table 5-3, Resistor Selection Record, and return switch up.

ADJUSTMENTS

5-25. FM DEVIATION ADJUSTMENT (Cont'd)

23. Select nearest standard value resistors to those resistances measured in step 22 and solder them in place of A5R4 (2B), R23 (2S), and R44 (2E). Enter values in Table 5-3. A listing of standard value resistors (±1% tolerance) and corresponding HP part numbers is found in Table 5-4.

24. Reconnect DIP plugs A1A5P1 and P2 to the A5 FM Driver Board Assembly. (Do not disconnect the test cable from A5J3. However, check that all slide switches on the adjustment board are down.) Tune across the range noting FM deviation as indicated on counter. Counter readings should be 60.0 ± 3.6 kHz.

NOTES

If counter reading is not within tolerance, the error may be due to test cable and contact resistances in the FM Deviation Adjustment Board. Replace resistors with the next higher standard value resistors and measure again.

Allow time for resistors to cool before making measurement.

10–19, 35–66, 66–130, 130–270 MHz Range Adjustments

NOTE

Perform steps 25 through 42 one range at a time and return to step 25 after each range.

25. Connect FM Deviation Adjustment Board (step 4) and set controls as in step 6.

26. Set FREQUENCY RANGE as listed below and tune across nominal range stopping at each turn of knob to check counter. Counter should read 60.0 ± 3.6 kHz for all frequencies.

FREQUENCY RANGE (MHz)
10–19
35–66
66–130
130–270

27. If frequency deviation was correct, proceed to next frequency range and repeat step 26.

NOTE

If frequency deviation was uniformly too high or low, proceed with the following steps but remove only the resistor related to the "G" adjustment and adjust only G on the Adjustment Board (BP, SL, and E switches down).

ADJUSTMENTS

5-25. FM DEVIATION ADJUSTMENT (Cont'd)

28. If frequency deviation was incorrect, unsolder and lift one end of resistors listed below.

FREQUENCY RANGE (MHz)	Resistors			
	BP	SL	E	G
10—19	A5R2 (1B)	A5R22 (1S)	A5R48 (1E)	A5R66 (1G)
35—66	A5R6 (3B)	A5R24 (3S)	A5R40 (3E)	A5R70 (3G)
66—130	A5R8 (4B)	A5R25 (4S)	A5R38 (4E)	A5R72 (4G)
130—270	A5R10 (5B)	A5R28 (5S)	A5R35 (5E)	A5R74 (5G)

29. Set BP, SL, E, and G switches on Adjustment board up.

30. Tune to frequency listed below. Adjust G potentiometer on Adjustment Board for counter reading of 60.0 ± 0.2 kHz.

FREQUENCY RANGE (MHz)	Frequency Set (MHz)
10—19	13.3
35—66	47
66—130	91
130—270	180

31. Tune to frequency listed below. Adjust E potentiometer on Adjustment Board for counter reading of 60.0 ± 0.6 kHz.

FREQUENCY RANGE (MHz)	Frequency Set (MHz)
10—19	19
35—66	66
66—130	130
130—270	270

32. Tune back to frequency of step 30 stopping at each turn of knob to check counter. To aid in visualizing deviation flatness, plot counter readings on Figure 5-9. Counter should read 60.0 ± 3.6 kHz for these frequencies.

33. If frequency deviation was incorrect, readjust potentiometers G and E on Adjustment Board for best compromise.

34. Tune down in frequency below that of step 30 until deviation increases 1 kHz above deviation at frequency of step 30. Adjust BP potentiometer on Adjustment Board for counter reading of 60.0 ± 0.2 kHz.

ADJUSTMENTS

5-25. FM DEVIATION ADJUSTMENT (Cont'd)

35. Tune to frequency listed below. Adjust SL potentiometer on Adjustment Board for counter reading of 60.0 ± 0.6 kHz.

FREQUENCY RANGE (MHz)	Frequency Set (MHz)
10—19	10
35—66	35
66—130	66
130—270	130

36. Tune back to frequency of step 30 stopping at each turn of knob to check counter. If desired, plot counter readings on Figure 5-9. Counter should read 60.0 ±3.6 kHz for all these frequencies.

37. If frequency deviation was incorrect, readjust BP and SL on Adjustment board for best compromise.

38. Recheck deviation across entire range. If deviation is not 60.0 ± 3.6 kHz, readjust BP, SL, E, and G potentiometers on Adjustment Board for best compromise.

39. Measure resistance of BP, SL, E, and G potentiometers by setting each corresponding switch down, noting resistance in Table 5-3, Resistor Selection Record, and returning switch up.

40. Select nearest standard value resistors to those resistances measured in step 39 and solder them in place of the resistors listed in step 28. Enter these values in Table 5-3. A listing of standard value resistors (±1% tolerance) and corresponding HP part number is found in Table 5-4.

41. Reconnect DIP plugs A1A5P1 and P2 to the A5 FM Driver Board Assembly. (Do not disconnect the test cable from A5J3. However, check that all slide switches on adjustment board are down.) Tune across range noting deviation as indicated on the counter. Counter readings should be 60.0 ± 3.6 kHz.

NOTES

If counter reading is not within tolerance, the error may be due to test cable and contact resistances in the FM Deviation Adjustment Board. Replace resistors with the next higher standard value resistors and measure again.

Allow enough time for resistors to cool before making measurements.

42. If all ranges listed in step 25 have been adjusted, proceed to step 43; if not, proceed to next range and begin at step 25.

ADJUSTMENTS

5-25. FM DEVIATION ADJUSTMENT (Con't)

270–520 MHz Range Adjustment

43. Connect FM Deviation Adjustment Board (step 4) and set controls as in step 6.

44. Set FREQUENCY RANGE to 270–520 MHz and tune between 270 and 520 MHz stopping at each turn of knob to check counter. Counter should read 60.0±3.6 kHz for all frequencies.

45. If frequency deviation was correct, proceed to step 64.

NOTE

If frequency deviation was uniformly too high or low, proceed with the following steps but remove only resistor A5R76 (6G) and adjust only potentiometer G on the Adjustment Board (BP, SL, E, BP7, and SL7 switches down).

46. If frequency deviation was incorrect, unsolder and lift one end of resistors A5R12 (6B), R14 (7B), R29 (6S), R30 (7S), R33 (6E), and R76 (6G).

47. Set BP, SL, E, G, BP7, and SL7 switches on Adjustment Board up.

48. Tune frequency to 370 MHz. Adjust G potentiometer on Adjustment Board for counter reading of 60.0 ± 0.2 kHz.

49. Tune frequency to 520 MHz. Adjust E potentiometer on Adjustment Board for counter reading of 60.0 ± 0.6 kHz.

50. Tune back to 370 MHz stopping at each turn of the knob to check counter. To aid in visualizing deviation flatness, plot counter readings on Figure 5-9. Counter should read 60.0 ± 3.6 kHz for these frequencies.

51. If frequency deviation was incorrect, readjust potentiometers G and E on Adjustment Board for best compromise.

52. Tune down in frequency below 370 MHz until deviation increases 2 kHz above deviation at 370 MHz. Adjust BP potentiometer on Adjustment Board for counter reading of 60.0 ± 0.2 kHz. Note carrier frequency.

53. Continue tuning down in frequency to 50 MHz below frequency noted in step 52. Note this frequency. Adjust SL potentiometer on Adjustment Board for counter reading of 60.0 ± 0.6 kHz.

54. Tune back to frequency noted in step 52 stopping at each turn of knob to check counter. If desired, plot counter readings on Figure 5-9. Counter should read 60.0 ± 3.6 kHz.

55. If frequency deviation was incorrect, readjust potentiometers BP and SL on Adjustment Board for best compromise for frequencies between 370 MHz and that noted in step 53.

ADJUSTMENTS

5-25. FM DEVIATION ADJUSTMENT (Cont'd)

56. Continue tuning down in frequency until deviation increases to 61.5 kHz. Adjust BP7 potentiometer on Adjustment Board for counter reading of 60.0 ± 0.2 kHz.

57. Tune frequency to 270 MHz. Adjust SL7 potentiometer on Adjustment board for counter reading of 60.0 ± C.6 kHz.

58. Tune back to frequency noted in step 53 stopping at each turn of knob to check counter. If desired, plot counter readings on Figure 5-9. Counter should read 60.0 ± 3.6 kHz.

59. If frequency deviation was incorrect, readjust potentiometers BP7 and SL7 on Adjustment Board for best compromise.

60. Recheck deviation from 270 to 520 MHz. If deviation is not 60.0 ± 3.6 kHz, readjust potentiometers BP, SL, E, BP7, and SL7 on Adjustment Board for best compromise.

NOTE

On this range all adjustments are interactive. Before readjusting any control, consider its effect as shown in Figure 5-7, then make only a slight adjustment of the control and note its effect. Adjustment to much better than 60.0 ± 3.6 kHz is not recommended.

61. Measure resistance of BP, SL, E, G, BP2, and SL2 potentiometers by setting each corresponding switch down, noting resistance, and returning switch up.

62. Select nearest standard value resistors to those resistances measured in step 61 and solder them in place of A5R12 (6B), R14 (7B), R29 (6S), R30 (7S), R33 (6E) and R76 (6G). Enter values in Table 5-3. A listing of standard value resistors (±1% tolerance) and corresponding HP part numbers is found in Table 5-4.

63. Reconnect DIP plugs A1A5P1 and P2 to the A5 FM Driver Board Assembly. (Do not disconnect the test cable from A5J3. However, ensure that all slide switches on adjustment board are down.) Counter reading should be 60.0 ± 3.6 kHz.

NOTES

If counter reading is not within tolerance, the error may be due to test cable and contact resistance in the FM Deviation Adjustment Board. Replace resistors with next higher standard value resistors and measure again.

Allow enough time for resistors to cool before making measurements.

FM Range Adjustment

64. Connect FM Deviation Adjustment Board (step 4) and set controls as in steps 5 and 6. (If alternate procedure of paragraph 5-25A is being used, set OUTPUT LEVEL switch to −20 dBm.) Set BP, SL, E and G switches down. Set FREQUENCY RANGE on Signal Generator to 19—35 MHz.

ADJUSTMENTS

5-25. FM DEVIATION ADJUSTMENT (Cont'd)

65. Tune frequency until counter reading of 60.0 ± 0.2 kHz is noted. Set FM RANGE to 3 kHz.

66. Set counter GATE TIME to 100 ms. (If the alternate procedure of paragraph 5-25A is being used, consult step 9 of that procedure.)

67. Counter should read 6.00 ± 0.06 kHz. If it does not, insert (but do not solder) a resistor of a value that gives correct deviation in place of A5R80 (3 kHz) — try 1100Ω first. Then solder resistor in place.

68. Set FM RANGE to 30 kHz. Tune frequency until counter reading of 60.0 ±2.0 kHz is noted.

69. Set FM RANGE to 10 kHz. Counter should read 18.97 ± 0.19 kHz. If it does not, insert (but do not solder) a resistor of a value that gives correct deviation in place of A5R91 (10 kHz) — try 1470Ω first. Then solder resistor in place.

70. Set FM RANGE to 30 kHz. Set FREQUENCY RANGE to 66—130 MHz. Adjust FREQUENCY TUNE above 80 MHz until counter indicates 60.0 ± 0.2 kHz.

71. Set FM RANGE to 100 kHz. Counter should read 189.7 ± 1.9 kHz. If it does not, insert (but do not solder) a resistor of a value that gives correct deviation in place of A5R84 (100 kHz) — try 34.8 kΩ first. Then solder resistor in place.

72. Remove Adjustment Board, reconnect ribbon cables and replace instrument top cover.

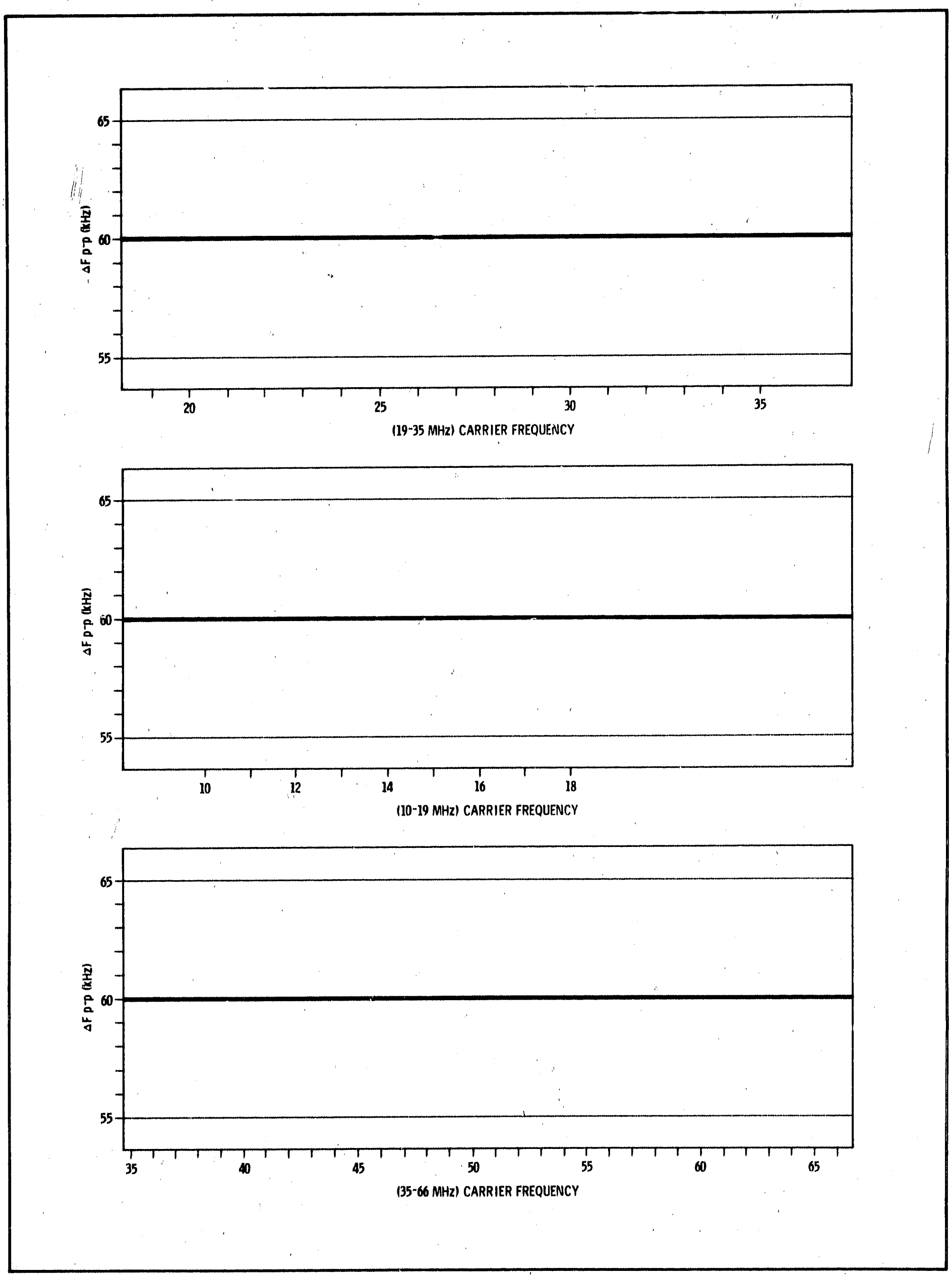


Figure 5-9. Counter Readings, FM Deviation vs. Carrier Frequency (1 of 2)

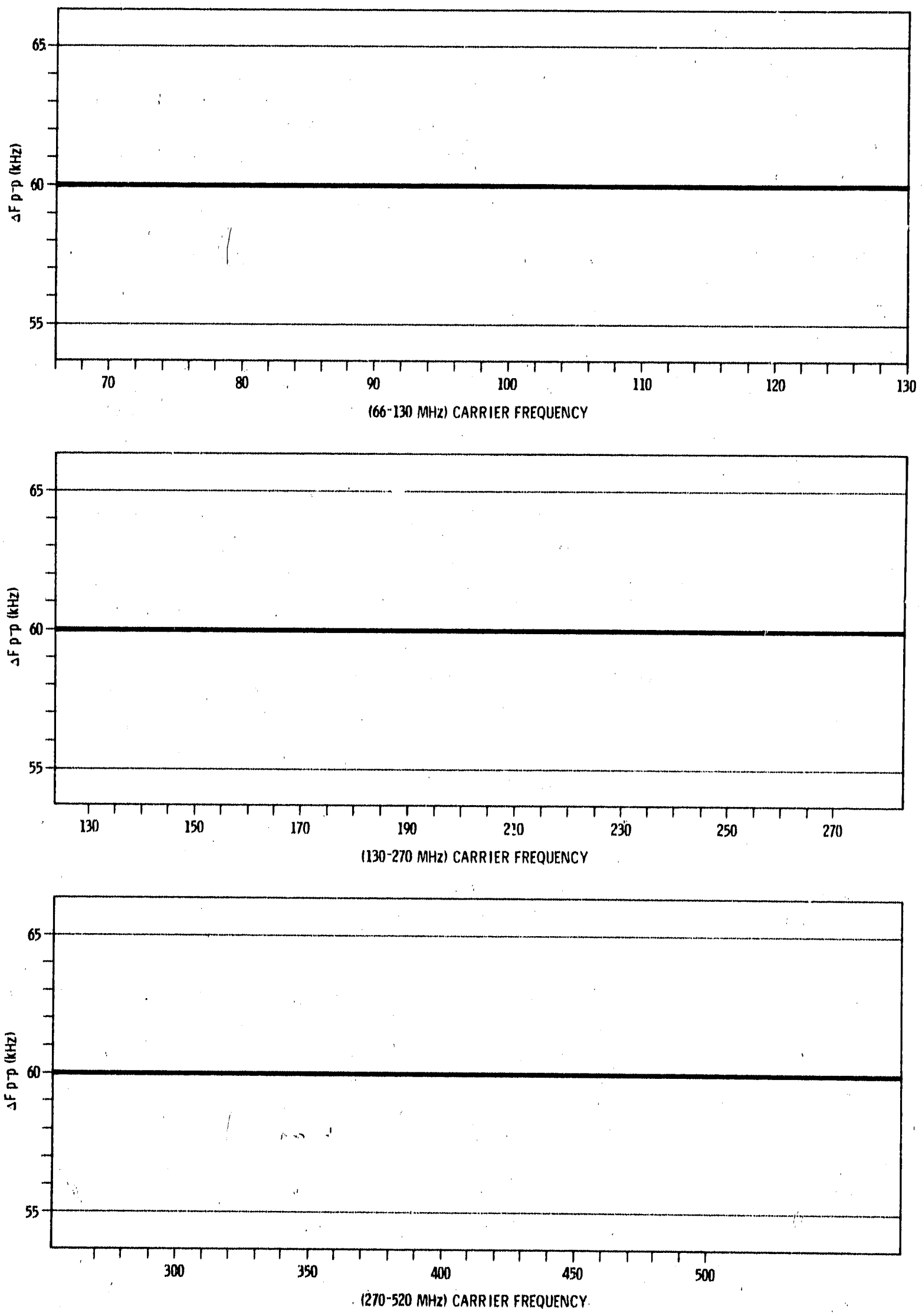


Figure 5-9. Counter Readings, FM Deviation vs. Carrier Frequency (2 of 2)

ADJUSTMENTS

Table 5-3. Resistor Selection Record

FREQUENCY RANGE	Adjustment	Mnemonic	Reference Designator A5	Measured Resistance	Selected Resistance
10—19 MHz	BP	1B	R2	_____	_____
	SL	1S	R22	_____	_____
	E	1E	R48	_____	_____
	G	1G	R66	_____	_____
19—35 MHz	BP	2B	R4	_____	_____
	SL	2S	R23	_____	_____
	E	2E	R44	_____	_____
35—66 MHz	BP	3B	R6	_____	_____
	SL	3S	R24	_____	_____
	E	3E	R40	_____	_____
	G	3G	R70	_____	_____
66—130 MHz	BP	4B	R8	_____	_____
	SL	4S	R25	_____	_____
	E	4E	R38	_____	_____
	G	4G	R72	_____	_____
130—270 MHz	BP	5B	R10	_____	_____
	SL	5S	R28	_____	_____
	E	5E	R35	_____	_____
	G	5G	R74	_____	_____
270—520 MHz	BP	6B	R12	_____	_____
	SL	6S	R29	_____	_____
	E	6E	R33	_____	_____
	G	6G	R76	_____	_____
	BP2	7B	R14	_____	_____
	SL2	7S	R30	_____	_____

Table 5-4. Standard Value Resistors (±1%, 1/8W, Metal Film)

Ohms	HP Part Number	Ohms	HP Part Number
51.1	0757-0394	4.64K	0698-3155
56.2	0757-0395	5.11K	0757-0438
61.9	0757-0276	5.62K	0757-0200
68.1	0757-0397	6.19K	0757-0290
75.0	0757-0398	6.81K	0757-0439
82.5	0757-0399	7.50K	0757-0440
		8.25K	0757-0441
90.9	0757-0400	9.09K	0757-0288
100	0757-0401		
110	0757-0402	10.0K	0757-0442
121	0757-0403	11.0K	0757-0443
133	0698-3437	12.1K	0757-0444
		13.3K	0757-0289
147	0698-3438	14.7K	0698-3156
162	0757-0405	16.2K	0757-0447
178	0698-3439	17.8K	0698-3136
196	0698-3440	19.6K	0698-3157
215	0698-3441		
237	0698-3442	21.5K	0757-0199
		23.7K	0698-3158
261	0698-3132	26.1K	0698-3159
287	0698-3443	28.7K	0698-3449
316	0698-3444	31.6K	0698-3160
348	0698-3445	34.8K	0757-0123
383	0698-3446	38.3K	0698-3161
		42.2K	0698-3450
422	0698-3447	46.4K	0698-3162
464	0698-0082	51.1K	0757-0458
511	0757-0416	56.2K	0757-0459
562	0757-0417	61.9K	0757-0460
619	0757-0418	68.1K	0757-0461
		75.0K	0757-0462
681	0757-0419	82.5K	0757-0463
750	0757-0420		
825	0757-0421	90.9K	0757-0464
909	0757-0422	100K	0757-0465
1.0K	0757-0280	110K	0757-0466
		121K	0757-0467
1.1K	0757-0424	133K	0698-3451
1.21K	0757-0274		
1.33K	0757-0317	147K	0698-3452
1.47K	0757-1094	162K	0757-0470
		178K	0698-3243
1.62K	0757-0428	196K	0698-3453
1.78K	0757-0278		
1.96K	0698-0083	215K	0698-3454
2.15K	0698-0084	237K	0698-3266
		261K	0698-3455
2.37K	0698-3150	287K	0698-3456
2.61K	0698-0085		
2.87K	0698-3151	316K	0698-3457
3.16K	0757-0279	348K	0698-3458
3.48K	0698-3152	383K	0698-3459
		422K	0698-3460
3.83K	0698-3153	464K	0698-3260
4.22K	0698-3154		

ADJUSTMENTS

5-25A. FM DEVIATION ADJUSTMENT (Alternate)

DESCRIPTION: If a 5345A/5354A or similar counter is not available, the FM Deviation Adjustment can also be performed with a computing controller (calculator) based counting system and a digital-to-analog converter. This procedure describes only the initial setup of the system. The remaining procedure is the same as in paragraph 5-25, steps 8 through 72. The description of paragraph 5-25 also applies. The special FM Deviation Adjustment Board is still used because the substitution potentiometers are required. The square wave circuitry on it is not used since its function is performed by the digital-to-analog converter.

The controller program sequences as follows:

1. The digital-to-analog converter is set to +0.95 Vdc, and its output is checked by a digital voltmeter.

2. The above step is repeated for −0.95 Vdc.

3. The digital-to-analog converter is set to +0.95 Vdc. (This voltage is applied to the generator's FM input.)

4. The counter is triggered and takes a frequency reading. The reading is subtracted from the previous reading (which initially is zero), and the absolute value of the difference frequency is displayed.

5. The digital-to-analog converter is set to −0.95 Vdc.

6. The counter is triggered and takes a frequency reading. The reading is subtracted from the previous reading, and the absolute value of the difference frequency is displayed.

7. Steps 3 through 6 above are repeated indefinitely.

NOTE

The counter displays the approximate carrier frequency. The controller displays the peak-to-peak FM deviation in kHz.

ADJUSTMENTS

5-25A. FM DEVIATION ADJUSTMENT (Alternate) (Cont'd)

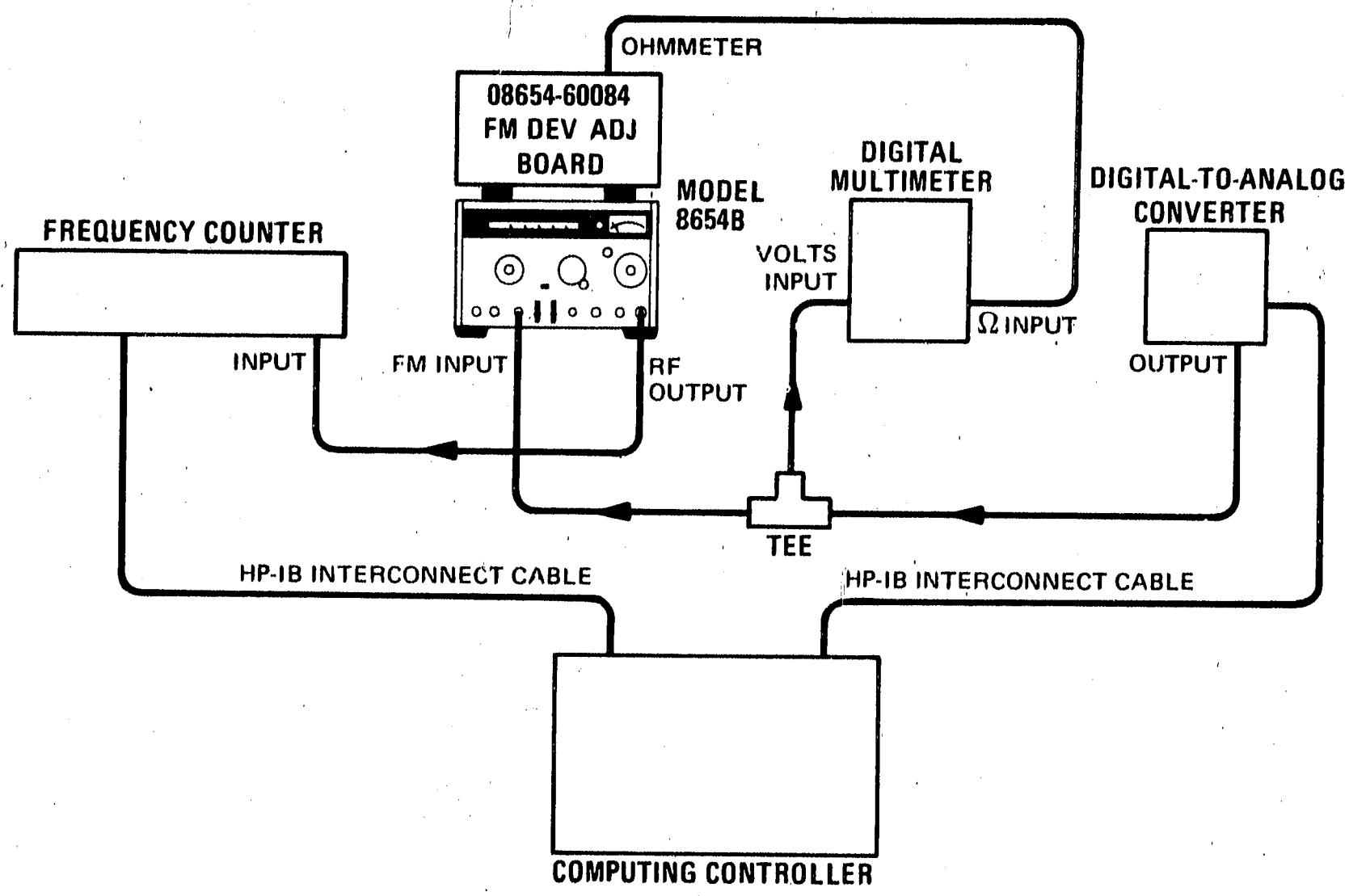


Figure 5-10. FM Deviation Adjustment (Alternate) Setup

EQUIPMENT:

Computing Controller	HP 9825A or 9830A
Frequency Counter	HP 5340A
Digital-to-Analog Converter	HP 59303A
Digital Multimeter	HP 34702A/34740A
FM Deviation Adjustment Board	HP 08654-60084

NOTE

The use of substitute equipment for the computing controller, frequency counter, or digital-to-analog converter will necessitate a change in software. The frequency counter should have a 520 MHz frequency range.

ADJUSTMENTS

5-25A. FM DEVIATION ADJUSTMENT (Alternate) (Cont'd)

PROCEDURE:

NOTE

Due to the complex nature of this adjustment, it is extremely important that you read and understand the information presented under DESCRIPTION of paragraph 5-25.

Initial Setup

1. Remove instrument top cover.

2. Mount FM Deviation Adjustment Board to rear panel (use two screws from top cover).

3. Interconnect instruments as shown in Figure 5-10.

NOTE

Check instrument interface bus addresses. The programs given below must be altered if the equipment uses ASCII addresses other than the following:

Instrument	Talk Address	Listen Address
HP 9825A or 9830A	U	5
HP 5340A	R	2
HP 59303A Program	—	9
Data	—	8

4. Remove two ribbon cables from A5 FM Driver Board Assembly and connect to corresponding connector jacks J1 and J2 on Adjustment Board. Connect three ribbon cables from Adjustment Board to corresponding connector jacks A5J1, J2, and J3 on A5 FM Driver Board Assembly.

5. Set Signal Generator controls as follows:

METER	LEVEL
FREQUENCY RANGE (MHz)	19—35 MHz
FREQUENCY TUNE	19 MHz
FINE TUNE	Centered
OUTPUT LEVEL Switch	—20 dBm
Output Level VERNIER	Meter reads +3 dB
AM	OFF
FM	EXT
FM RANGE	30 kHz
FM LEVEL	Fully cw

ADJUSTMENTS

5-25A. FM DEVIATION ADJUSTMENT (Alternate) (Cont'd)

6. Set Adjustment Board controls as follows:

BP Switch	Down
SL Switch	Down
E Switch	Down
G Switch	Down
BP7 Switch	Down
SL7 Switch	Down
BP Potentiometer	Fully cw
SL Potentiometer	Fully cw
E Potentiometer	Fully ccw
G Potentiometer	Fully ccw
BP7 Potentiometer	Fully cw
SL7 Potentiometer	Fully cw

7. Program the calculator as follows:

9825A

```
0: fxd 1
1: dev "d/ap",525,"d/ad",524,"ctr",518
2: wrt "ctr","2P@KMOH"
3: wrt "d/ap","E0";fmt 1,f5.0;wrt "d/ad.1",95
4: dsp "Check d/a out: 946 to 952 mV.";stp
5: wrt "d/ad.1",-95
6: dsp "Check d/a out: -946 to -952 mV.";stp ;0→B
7: wrt "d/ad.1",95
8: wrt "ctr","I";fmt 2,3x,e12.0
9: red "ctr.2",A;dsp abs(A-B)/1000
10: wrt "d/ad.1",-95
11: wrt "ctr","I"
12: red "ctr.2",B;dsp abs(A-B)/1000
13: gto 7
14: end
*19966
```

Sets counter controls.

Sets d/a converter controls; sets d/a converter to +0.95 Vdc.

Check voltmeter reading, then press CONTINUE.

Sets d/a converter to −0.95 Vdc.

Check voltmeter reading, then press CONTINUE.

Sets d/a converter to +0.95 Vdc.

Triggers counter.

Displays peak-to-peak deviation.

Sets d/a converter to −0.95 Vdc.

Triggers counter.

Displays peak-to-peak deviation.

ADJUSTMENTS

5-25A. FM DEVIATION ADJUSTMENT (Alternate) (Cont'd)

9830A

```
10 FIXED 1
20 FORMAT F5.0
30 FORMAT 3X,E12.0
40 CMD "?U2","2P@KMOH"          ——— Sets counter controls. (@ is a SHIFT RESULT.)
50 CMD "?U9","E6","?U8"         ——— Sets d/a converter controls.
60 OUTPUT (13,20)95             ——— Sets d/a converter to +0.95 Vdc.
70 DISP "CHECK D/A OUT: 946 TO 952 MV"  ——— Check voltmeter reading, then press CONT EXECUTE.
80 STOP
90 OUTPUT (13,20)-95            ——— Sets d/a converter to −0.95 Vdc.
100 DISP "CHECK D/A OUT: -946 TO -952 MV" ——— Check voltmeter reading, then press CONT EXECUTE.
110 STOP
120 B=0
130 CMD "?U8"
140 OUTPUT (13,20)95            ——— Sets d/a converter to +0.95 Vdc.
150 CMD "?U2";"I","?R5"         ——— Triggers counter.
160 ENTER (13,30)A
170 DISP ABS(A-B)/1000          ——— Displays peak-to-peak deviation.
180 CMD "?U8"
190 OUTPUT (13,20)-95           ——— Sets d/a converter to −0.95 Vdc.
200 CMD "?U2";"I","?R5"         ——— Triggers counter.
210 ENTER (13,30)B
220 DISP ABS(A-B)/1000          ——— Displays peak-to-peak deviation.
230 GOTO 130
240 END
```

8. Set multimeter to read 1 Vdc. Run program. The program stops with the output of the digital-to-analog converter set to +0.95 Vdc. Confirm this voltage by observing the multimeter display. Press continue. Confirm −0.95 Vdc at digital-to-analog converter output. Press continue.

9. Switch the digital multimeter to read ohms. Continue on with step 8 of paragraph 5-25. During the procedure, read the peak-to-peak deviation from the controller display.

10. In place of step 66 of paragraph 5-25, change the following controller program steps as indicated below:

9825A

```
0: fxd 2
2: wrt "ctr","1P@KMOH"
```

9830A

```
10 FIXED 2
40 CMD "?U2","1P@KMOH"
```

ADJUSTMENTS

5-26. OUTPUT IMPEDANCE ADJUSTMENT (Option 003 only)

REFERENCE: Service Sheet 3A.

DESCRIPTION: A tracking generator is used as an external 50Ω signal source to feed an SWR bridge. The output connector of the bridge is connected to a spectrum analyzer. The through connector of the bridge is connected to a short circuit to establish a reference, then to the output of A6 Reverse Power Protection Assembly. Return loss versus frequency is displayed on the spectrum analyzer.

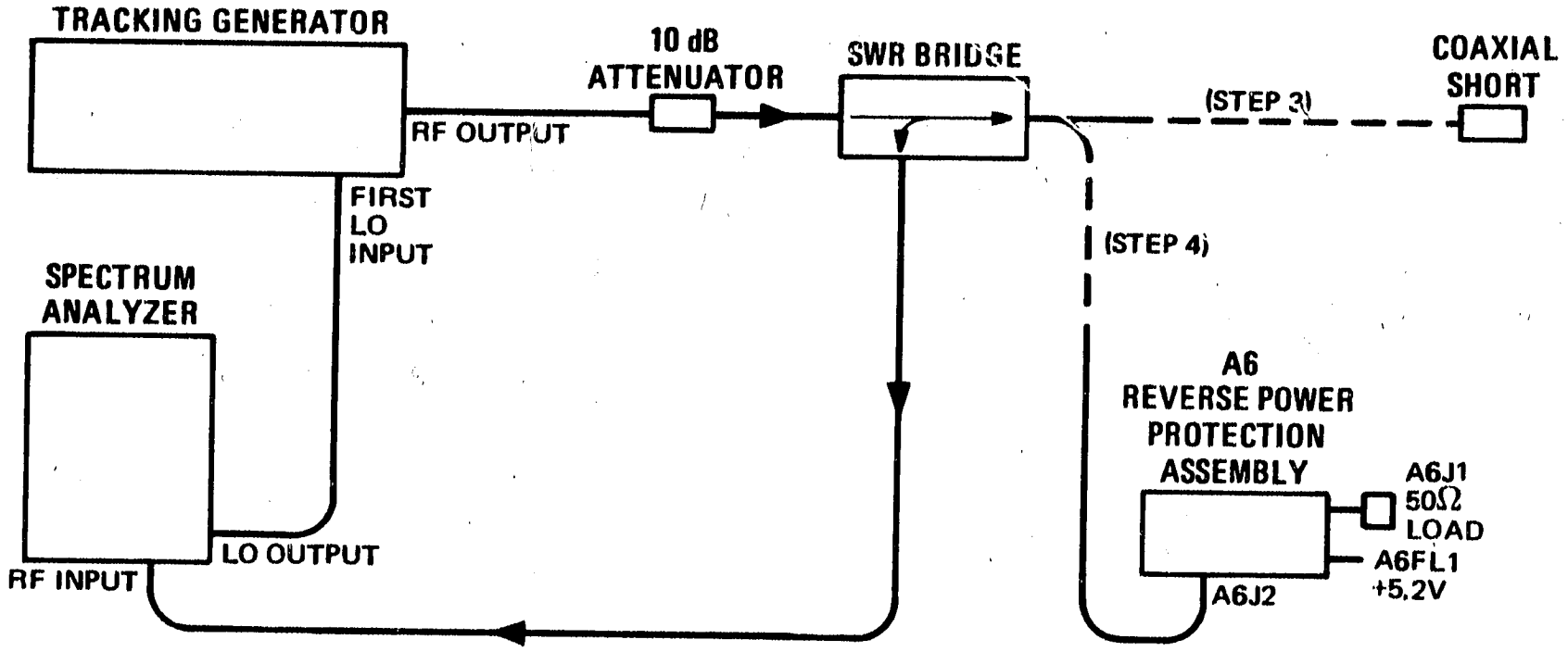


Figure 5-11. Output Impedance Adjustment Setup (Option 003)

EQUIPMENT:

Tracking Generator	HP 8444A, Opt. 058
Spectrum Analyzer	HP 8558B/182C
SWR Bridge	Wiltron 60N50
Coaxial Short	HP 11512A
10 dB Attenuator	HP 8491A Opt 10
50Ω Load	HP 908A

PROCEDURE:

1. Remove bottom RF Section Assembly support bar (see Service Sheet B for location).

2. Remove cables and screws securing A6 Reverse Power Protection Assembly. Orient assembly so that circuit components are accessible and the +5.2V supply and ground (if needed) are connected.

3. Connect equipment as shown in Figure 5-11.

4. Set spectrum analyzer resolution bandwidth to 300 kHz or greater, optimum input level to −20 dBm (20 dB attenuation), and frequency controls for a frequency span of 0 to 500 MHz. Set tracking generator output for 0 dBm.

5. To establish a reference level, set LINE to OFF and connect coaxial short to bridge output jack. Use the spectrum analyzer's vertical reference level controls to set

ADJUSTMENTS

5-26. OUTPUT IMPEDANCE ADJUSTMENT (Option 003 only) (Cont'd)

swept signal display to top graticule line of display with 10 dB per division log vertical scale.

6. Remove coaxial short and connect bridge output to output jack A6J2.

7. Set Signal Generator LINE to ON.

8. The level now shown on the spectrum analyzer should be greater than 18 dB down from the reference level set in step 5. If not, adjust FLATNESS ADJ, A6A1C9, or A6A1L1 and L2 for minimum level (i.e., maximum return loss). A6A1L1 and L2 can be adjusted by bending them, or raising and lowering them after they are desoldered.

NOTE

If adjustment seems necessary, check the return loss of the 50Ω load alone by connecting it to the bridge output. Return loss should be greater than 30 dB.

5-27. REVERSE POWER LEVEL SENSE ADJUSTMENT (Option 003 only)

REFERENCE: Service Sheet 3A.

DESCRIPTION: The output jack, A6J2 of Reverse Power Protection Assembly (A6) is driven by a 1 MHz source. Input jack A6J1 is monitored by a high impedance ac voltmeter. The LEVEL SENSE ADJ is set to trip the Level Sensor at a signal level of 1.8 Vrms.

NOTE

This procedure is also useful for verifying the operation of the reverse power protection without endangering the generator output circuitry.

EQUIPMENT:

Test Oscillator	HP 651B
Digital Voltmeter	HP 34702A/34740A

PROCEDURE:

1. Remove bottom RF Section Assembly support bar (see Service Sheet B for location.

2. Remove cables and screws securing A6 Reverse Power Protection Assembly. Orient assembly so that circuit components are accessible and the +5.2V supply and ground (if needed) are connected.

3. Connect voltmeter to input jack A6J1.

4. Connect 50Ω output of test oscillator to output jack A6J1. Set test oscillator frequency to 1 MHz at approximately 3 Vrms into an open circuit.

5. Set Signal Generator LINE to ON.

ADJUSTMENTS

5-27. REVERSE POWER LEVEL SENSE ADJUSTMENT (Option 003 only) (Cont'd)

6. Slowly increase test oscillator level until the reading on the voltmeter switches to zero. Note the signal level at which this occurs. The signal level should be between 1.7 and 1.9 Vrms. If the signal level is incorrect, adjust A6A1R2, LEVEL SENSE ADJ., until switching occurs within the correct limits.

NOTE

Always approach switching point from a lower level. The Level Sensor has a small amount of hysteresis causing the switching point to be lower for a decreasing signal level than for an increasing level.

CAUTION

Avoid setting the switching point below the stated limits. The Signal Generator's own output can trip the Level Sensor (particularly during low frequency, open-circuit operation). This condition can cause relay contact chatter and reduce contact life.

PARTS LIST

SECTION VI
REPLACEABLE PARTS

6-1. INTRODUCTION

6-2. This section contains information for ordering parts. Table 6-1 lists abbreviations used in the parts list and throughout the manual. Table 6-2 lists all replaceable parts in reference designation order. Table 6-3 contains the names and addresses that correspond with the manufacturers' code numbers.

6-3. EXCHANGE ASSEMBLIES

6-4. Certain assemblies within the instrument may be replaced on an exchange basis, thus affording a considerable cost saving. Exchange, factory-repaired, and tested assemblies are available only on a trade-in basis; therefore, the defective assemblies must be returned for credit. For this reason, assemblies required for spare parts stock must be ordered by the new assembly part number. Listings for exchange assemblies (if available) may be found directly following the corresponding new assembly listing in Table 6-2.

6-5. ABBREVIATIONS

6-6. Table 6-1 lists abbreviations used in the parts list, schematics and throughout the manual. In some cases, two forms of the abbreviation are used, one all in capital letters, and one partial or no capitals. This occurs because the abbreviations in the parts list are always all capitals. However, in the schematics and other parts of the manual, other abbreviation forms are used with both lower case and upper case letters.

6-7. REPLACEABLE PARTS LIST

6-8. Table 6-2 is the list of replaceable parts and is organized as follows:

a. Electrical assemblies and their components in alpha-numerical order by reference designation.

b. Chassis-mounted parts in alpha-numerical order by reference designation.

c. Miscellaneous parts.

The information given for each part consists of the following:

a. The Hewlett-Packard part number.

b. The total quantity (Qty) used in the instrument.

c. The description of the part.

d. A typical manufacturer of the part in a five-digit code.

e. The manufacturer's number for the part.

The total quantity for each part is given only once at the first appearance of the part number in the list. Total quantities for optional assemblies are totaled by assembly and not integrated into the standard list.

6-9. ORDERING INFORMATION

6-10. To order a part listed in the replaceable parts table, quote the Hewlett-Packard part number, indicate the quantity required, and address the order to the nearest Hewlett-Packard office.

6-11. To order a part that is not listed in the replaceable parts table, include the instrument model number, instrument serial number, description and function of the part, and number of parts required. Address the order to the nearest Hewlett-Packard office.

6-12. PARTS PROVISIONING

6-13. Stocking spare parts for an instrument is often done to ensure quick return to service after a malfunction occurs. Hewlett-Packard has a "Spare Parts Kit" available for this purpose. The kit consits of selected replaceable assemblies and components for this instrument. The contents of the kit and the "Recommended Spares" list are based on failure reports and repair data and provides parts support for one year. A complimentary "Recommended Spares" list for this instrument may be obtained on request and the "Spare Parts Kit" may be ordered through your nearest Hewlett-Packard office.

6-14. ILLUSTRATED PARTS BREAKDOWNS

6-15. An illustrated parts breakdown of the A1 RF Section Assembly is given on Service Sheet A located after the numerical foldouts in Section VIII. In addition cabinet and front panel mechanical parts breakdowns appear in this section.

Table 6-2. Reference Designations and Abbreviations (1 of 2)

REFERENCE DESIGNATIONS

A . . . . . assembly
AT . . attenuator; isolator; termination
B . . . . . fan; motor
BT . . . . . battery
C . . . . . capacitor
CP . . . . . coupler
CR . . . . . diode; diode thyristor; varactor
DC . . . directional coupler
DL . . . . . delay line
DS . . . . . annunciator; signaling device (audible or visual); lamp; LED
E . . . . . miscellaneous electrical part
F . . . . . fuse
FL . . . . . filter
H . . . . . hardware
HY . . . . . circulator
J . . . electrical connector (stationary portion); jack
K . . . . . relay
L . . . . . coil; inductor
M . . . . . meter
MP . . . . . miscellaneous mechanical part
P . . . electrical connector (movable portion); plug
Q . . . . . transistor; SCR; triode thyristor
R . . . . . resistor
RT . . . . . thermistor
S . . . . . switch
T . . . . . transformer
TB . . . . . terminal board
TC . . . . . thermocouple
TP . . . . . test point
U . . . . . integrated circuit; microcircuit
V . . . . . electron tube
VR . . . . voltage regulator; breakdown diode
W . . . . cable; transmission path; wire
X . . . . . socket
Y . . . . crystal unit (piezoelectric or quartz)
Z . . . . tuned cavity; tuned circuit

ABBREVIATIONS

A . . . . . ampere
ac . . . . alternating current
ACCESS . . . . . accessory
ADJ . . . . . adjustment
A/D . . . . analog-to-digital
AF . . . . . audio frequency
AFC . . . . . automatic frequency control
AGC . . . . . automatic gain control
AL . . . . . aluminum
ALC . . . . automatic level control
AM . . . amplitude modulation
AMPL . . . . . amplifier
APC . . . . automatic phase control
ASSY . . . . . assembly
AUX . . . . . auxiliary
avg . . . . . average
AWG . . . . American wire gauge
BAL . . . . . balance
BCD . . . . . binary coded decimal
BD . . . . . board
BE CU . . . . . beryllium copper
BFO . . . . . beat frequency oscillator
BH . . . . . binder head
BKDN . . . . . breakdown
BP . . . . . bandpass
BPF . . . . . bandpass filter
BRS . . . . . brass
BWO . . . . . backward-wave oscillator
CAL . . . . . calibrate
ccw . . counter-clockwise
CER . . . . . ceramic
CHAN . . . . . channel
cm . . . . . centimeter
CMO . . cabinet mount only
COAX . . . . . coaxial
COEF . . . . . coefficient
COM . . . . . common
COMP . . . . . composition
COMPL . . . . . complete
CONN . . . . . connector
CP . . . . . cadmium plate
CRT . . . cathode-ray tube
CTL . . . . complementary transistor logic
CW . . . . . continuous wave
cw . . . . . clockwise
cm . . . . . centimeter
D/A . . . . digital-to-analog
dB . . . . . decibel
dBc . . decibels below carrier
dBm . . . . decibel referred to 1 mW
dc . . . . . direct current
deg . . degree (temperature interval or difference)
° . . . . . degree (plane angle)
°C . . . . . degree Celsius (centigrade)
°F . . . . degree Fahrenheit
°K . . . . . degree Kelvin
DEPC . . deposited carbon
DET . . . . . detector
diam . . . . . diameter
DIA . . . diameter (used in parts list)
DIFF AMPL . . differential amplifier
div . . . . . division
DPDT . . . . . double-pole, double-throw
DR . . . . . drive
DSB . . . . double sideband
DTL . . . . diode transistor logic
DVM . . . digital voltmeter
ECL . . . . emitter coupled logic
EMF . . electromotive force
EDP . . . . . electronic data processing
ELECT . . . . . electrolytic
ENCAP . . . . encapsulated
EXT . . . . . external
F . . . . . farad
FET . . . . . field-effect transistor
F/F . . . . . flip-flop
FH . . . . . flat head
FIL H . . . . . fillister head
FM . . frequency modulation
FP . . . . . front panel
FREQ . . . . . frequency
FXD . . . . . fixed
g . . . . . gram
GE . . . . . germanium
GHz . . . . . gigahertz
GL . . . . . glass
GRD . . . . . ground(ed)
H . . . . . henry
h . . . . . hour
HET . . . . . heterodyne
HEX . . . . . hexagonal
HD . . . . . head
HDW . . . . . hardware
HF . . . . . high frequency
HG . . . . . mercury
HI . . . . . high
HP . . . . . Hewlett-Packard
HPF . . . . . high pass filter
HR . . . . . hour (used in parts list)
HV . . . . . high voltage
Hz . . . . . Hertz
IC . . . . integrated circuit
ID . . . . . inside diameter
IF . . . . . intermediate frequency
IMPG . . . . . impregnated
in . . . . . inch
INCD . . . . . incandescent
INCL . . . . . include(s)
INP . . . . . input
INS . . . . . insulation
INT . . . . . internal
kg . . . . . kilogram
kHz . . . . . kilohertz
kΩ . . . . . kilohm
kV . . . . . kilovolt
lb . . . . . pound
LC . . . . . inductance-capacitance
LED . . light-emitting diode
LF . . . . . low frequency
LG . . . . . long
LH . . . . . left hand
LIM . . . . . limit
LIN . . . linear taper (used in parts list)
lin . . . . . linear
LK WASH . . . lock washer
LO . . . low; local oscillator
LOG . . . . logarithmic taper (used in parts list)
log . . . . . logrithm(ic)
LPF . . . . . low pass filter
LV . . . . . low voltage
m . . . . . meter (distance)
mA . . . . . milliampere
MAX . . . . . maximum
MΩ . . . . . megohm
MEG . . . . meg (10^6) (used in parts list)
MET FLM . . . . metal film
MET OX . . metallic oxide
MF . . . medium frequency; microfarad (used in parts list)
MFR . . . . . manufacturer
mg . . . . . milligram
MHz . . . . . megahertz
mH . . . . . millihenry
mho . . . . . mho
MIN . . . . . minimum
min . . . . . minute (time)
' . . . . . minute (plane angle)
MINAT . . . . . miniature
mm . . . . . millimeter

NOTE

All abbreviations in the parts list will be in upper-case.

Table 6-2. Reference Designations and Abbreviations (2 of 2)

MOD . . . . . modulator
MOM . . . . . momentary
MOS . . . . . metal-oxide semiconductor
ms . . . . . millisecond
MTG . . . . . mounting
MTR . . . meter (indicating device)
mV . . . . . millivolt
mVac . . . . . millivolt, ac
mVdc . . . . . millivolt, dc
mVpk . . . . millivolt, peak
mVp-p . . . millivolt, peak-to-peak
mVrms . . . . millivolt, rms
mW . . . . . milliwatt
MUX . . . . . multiplex
MY . . . . . mylar
μA . . . . . microampere
μF . . . . . microfarad
μH . . . . . microhenry
μmho . . . . . micromho
μs . . . . . microsecond
μV . . . . . microvolt
μVac . . . . . microvolt, ac
μVdc . . . . . microvolt, dc
μVpk . . . microvolt, peak
μVp-p . . . microvolt, peak-to-peak
μVrms . . . . microvolt, rms
μW . . . . . microwatt
nA . . . . . nanoampere
NC . . . . . no connection
N/C . . . . normally closed
NE . . . . . neon
NEG . . . . . negative
nF . . . . . nanofarad
NI PL . . . . . nickel plate
N/O . . . . . normally open
NOM . . . . . nominal
NORM . . . . . normal
NPN . . . negative-positive-negative
NPO . . . . negative-positive zero (zero temperature coefficient)
NRFR . . not recommended for field replacement
NSR . . . . . not separately replaceable
ns . . . . . nanosecond
nW . . . . . nanowatt
OBD . . . order by description
OD . . . . . outside diameter
OH . . . . . oval head
OP AMPL . . . operational amplifier
OPT . . . . . .
OSC . . . . . .
OX . . . . . .
oz . . . . . o.
Ω . . . . . .
P . . . . peak (used as in list)
PAM . . . . pulse-amplitude modulation
PC . . . . . printed circuit
PCM . . pulse-code modulation; pulse-count modulation
PDM . . . . . pulse-duration modulation
pF . . . . . picofarad
PH BRZ phosphor bronze
PHL . . . . . Phillips
PIN . . . positive-intrinsic-negative
PIV . . . . . peak inverse voltage
pk . . . . . peak
PL . . . . . phase lock
PLO . . . . . phase lock oscillator
PM . . . . phase modulation
PNP . . . positive-negative-positive
P/O . . . . . part of
POLY . . . . . polystyrene
PORC . . . . . porcelain
POS . . positive; position(s) (used in parts list)
POSN . . . . . position
POT . . . . . potentiometer
p-p . . . . . peak-to-peak
PP . . . peak-to-peak (used in parts list)
PPM . . . . . pulse-position modulation
PREAMPL . . . preamplifier
PRF . . . . pulse-repetition frequency
PRR . . . . pulse repetition rate
ps . . . . . picosecond
PT . . . . . point
PTM . . . . . pulse-time modulation
PWM . . . . . pulse-width modulation
PWV . . . . . peak working voltage
RC . . . . . resistance-capacitance
RECT . . . . . rectifier
REF . . . . . reference
REG . . . . . regulated
REPL . . . . . replaceable
RF . . . . . radio frequency
RFI . . . . radio frequency interference
RH . . . . round head; right hand
RLC . . . . . resistance-inductance-capacitance
RMO . . . rack mount only
rms . . . . root-mean-square
RND . . . . . round
ROM . . read-only memory
R&P . . . . . rack and panel
RWV . . . reverse working voltage
S . . . scattering parameter
s . . . . . second (time)
. . . " . second (plane angle)
S-B . . . . . slow-blow (fuse) (used in parts list)
SCR . . . silicon controlled rectifier; screw
SE . . . . . selenium
SECT . . . . . sections
SEMICON . . . . . semiconductor
SHF . . . . . superhigh frequency
SI . . . . . silicon
SIL . . . . . silver
SL . . . . . slide
SNR . . signal-to-noise ratio
SPDT . . . . . single-pole, double-throw
SPG . . . . . spring
SR . . . . . split ring
SPST . . . . . single-pole, single-throw
SSB . . . . . single sideband
SST . . . . . stainless steel
STL . . . . . steel
SQ . . . . . square
SWR . . standing-wave ratio
SYNC . . . . . synchronize
T . . timed (slow-blow fuse)
TA . . . . . tantalum
TC . . . . . temperature compensating
TD . . . . . time delay
TERM . . . . . terminal
TFT . . thin-film transistor
TGL . . . . . toggle
THD . . . . . thread
THRU . . . . . through
TI . . . . . titanium
TOL . . . . . tolerance
TRIM . . . . . trimmer
TSTR . . . . . transistor
TTL . . transistor-transistor logic
TV . . . . . television
TVI television interference
TWT . . traveling wave tube
U . . . . . micro (10^{-6}) (used in parts list)
UF . . . microfarad (used in parts list)
UHF . . ultrahigh frequency
UNREG . . . . unregulated
V . . . . . volt
VA . . . . . voltampere
Vac . . . . . volts, ac
VAR . . . . . variable
VCO . . . voltage-controlled oscillator
Vdc . . . . . volts, dc
VDCW . . volts, dc, working (used in parts list)
V(F) . . . . . volts, filtered
VFO . . variable-frequency oscillator
VHF . . . . . very-high frequency
Vpk . . . . . volts, peak
Vp-p . . volts, peak-to-peak
Vrms . . . . . volts, rms
VSWR . . . voltage standing wave ratio
VTO . . . . . voltage-tuned oscillator
VTVM . . . . vacuum-tube voltmeter
V(X) . . . . . volts, switched
W . . . . . watt
W/ . . . . . with
WIV . . . . working inverse voltage
WW . . . . . wirewound
W/O . . . . . without
YIG . . yttrium-iron-garnet
Z_o . . . . . characteristic impedance

NOTE

All abbreviations in the parts list will be in upper-case.

MULTIPLIERS

Abbreviation	Prefix	Multiple
T	tera	10^{12}
G	giga	10^{9}
M	mega	10^{6}
k	kilo	10^{3}
da	deka	10
d	deci	10^{-1}
c	centi	10^{-2}
m	milli	10^{-3}
μ	micro	10^{-6}
n	nano	10^{-9}
p	pico	10^{-12}
f	femto	10^{-15}
a	atto	10^{-18}

Table 6-2. Replaceable Parts

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
A1	08654-60026	1	RF SECTION ASSEMBLY(EXCEPT OPTION 003)	28480	08654-60026
A1	08654-60049	1	RF SECTION ASSEMBLY(OPTION 003 ONLY)	28480	08654-60049
A1C1	0160-2049	1	CAPACITOR-FDTHRU 5000PF +80 -20% 500V	28480	0160-2049
A1C2	0180-0049	3	CAPACITOR-FXD 20UF+75-10% 50VDC AL	56289	30D206G050CC2
A1C3	0121-0016	1	CAPACITOR-V AIR DIEL 3.5/31.5PF 990V	94033	404-2
A1C4	0180-0089	3	CAPACITOR-FXD 10UF+50-10% 150VDC AL	56289	30D106F150DD2
A1E1	9170-0029	6	CORE-SHIELDING BEAD	02114	56-590-65A2/4A
A1E2	9170-0029		CORE-SHIELDING BEAD	02114	56-590-65A2/4A
A1E3	9170-0029		CORE-SHIELDING BEAD	02114	56-590-65A2/4A
A1E4	9170-0029		CORE-SHIELDING BEAD	02114	56-590-65A2/4A
A1E5	9170-0029		CORE-SHIELDING BEAD	02114	56-590-65A2/4A
A1E6	9170-0029		CORE-SHIELDING BEAD	02114	56-590-65A2/4A
A1E7	9170-0957	1	CORE, TOROID, N9R, P/O A1W1	02114	1041T060 3E2A
A1FL1	9135-0002	3	FILTER-LP SOLDER-TERMS	28480	9135-0002
A1FL2	9135-0002		FILTER-LP SOLDER-TERMS	28480	9135-0002
A1FL3	1810-0119	5	CAPACITOR FEED-THRU FILTER	01121	BE001-DA104P
A1FL4	1810-0119		CAPACITOR FEED-THRU FILTER	01121	BE001-DA104P
A1FL5	1810-0119		CAPACITOR FEED-THRU FILTER	01121	BE001-DA104P
A1FL6	1810-0119		CAPACITOR FEED-THRU FILTER	01121	BE001-DA104P
A1FL7	1810-0119		CAPACITOR FEED-THRU FILTER	01121	BE001-DA104P
A1FL8	9135-0002		FILTER-LP SOLDER-TERMS	28480	9135-0002
A1L1	9140-0114	3	COIL-MLD 10UH 10% Q=55 .155DX.375LG	99800	1537-36
A1L2	9140-0114		COIL-MLD 10UH 10% Q=55 .155DX.375LG	99800	1537-36
A1MP1	0360-0365	2	TERMINAL-LUG-SLDR 6 SCR .143/.093 ID	78189	2104-06-00
A1MP2	0360-0365		TERMINAL-LUG-SLDR 6 SCR .143/.093 ID	78189	2104-06-00
A1MP3	0360-0007	1	TERMINAL-LUG-SLDR 10 SCR .195/.1 ID HOLE	78189	2501-10-00
A1MP4	0510-0042	4	RETAINER-PUSH ON .125-DIA CD PL STL	0018A	1405-12-CD
A1MP5	0510-0042		RETAINER-PUSH ON .125-DIA CD PL STL	0018A	1405-12-CD
A1MP6	0510-0042		RETAINER-PUSH ON .125-DIA CD PL STL	0018A	1405-12-CD
A1MP7	0510-0042		RETAINER-PUSH ON .125-DIA CD PL STL	0018A	1405-12-CD
A1MP8	0510-0235	1	RETAINER-RING .375-DIA CD PL STL	97464	1000-37-ST-CD
A1MP9	0510-0294	1	PIN:SPRING SST 1/16 X 11/16" LG	00000	OBD
A1MP10	0890-0573	3	TUBING-FLEX .093-ID NPRN-RBR .063-WALL	76385	COMPOUND AX-1060
A1MP11	0890-0573		TUBING-FLEX .093-ID NPRN-RBR .063-WALL	76385	COMPOUND AX-1060
A1MP12	0890-0573		TUBING-FLEX .093-ID NPRN-RBR .063-WALL	76385	COMPOUND AX-1060
A1MP13	0890-0573		TUBING-FLEX .093-ID NPRN-RBR .063-WALL	76385	COMPOUND AX-1060
A1MP14	1200-0081	2	INSULATOR-BSHG-FLG NYLON	28480	1200-0087
A1MP15	1200-0081		INSULATOR-BSHG-FLG NYLON	28480	1200-0087
A1MP16	1400-0024	2	CLAMP-CA .25-DIA .5-WD NYL	71616	CPC 1953-4A
A1MP17	1460-0195	1	SPRING-EXT .125-OD .5-LG MUW	28480	1460-0195
A1MP18	1500-0432	1	BALL DRIVE 1.807-LG BRS/BRZ	28480	1500-0432
A1MP19	1530-1766	1	DAMP PAD, BACK(SPECIAL)	28480	1530-1766
A1MP20	1530-1767	1	DAMP PAD, COVER(SPECIAL)	28480	1530-1767
A1MP21	2190-0019	5	WASHER-LK HLCL NO.-4 .115-IN-ID	28480	2190-0019
A1MP22	2190-0019		WASHER-LK HLCL NO.-4 .115-IN-ID	28480	2190-0019
A1MP23	2190-0019		WASHER-LK HLCL NO.-4 .115-IN-ID	28480	2190-0019
A1MP24	2190-0124	3	WASHER-LK INTL T NO.-10 .195-IN-ID	74163	500222
A1MP25	2190-0124		WASHER-LK INTL T NO.-10 .195-IN-ID	74163	500222
A1MP26	2190-0124		WASHER-LK INTL T NO.-10 .195-IN-ID	74163	500222
A1MP27	2190-0888	2	WASHER-FL NM NO.-6 .156-IN-ID .25-IN-OD	28480	2190-0888
A1MP28	2190-0888		WASHER-FL NM NO.-6 .156-IN-ID .25-IN-OD	28480	2190-0888
A1MP29	2950-0078	3	NUT-HEX-DBL-CHAM 10-32-THD .067-THK	74163	500220
A1MP30	2950-0078		NUT-HEX-DBL-CHAM 10-32-THD .067-THK	74163	500220
A1MP31	2950-0078		NUT-HEX-DBL-CHAM 10-32-THD .067-THK	74163	500220
A1MP32	3030-0564	4	SCREW-SET 10-32 .875-IN-LG CUP-PT	28480	3030-0564
A1MP33	3030-0564		SCREW-SET 10-32 .875-IN-LG CUP-PT	28480	3030-0564
A1MP34	3030-0564		SCREW-SET 10-32 .875-IN-LG CUP-PT	28480	3030-0564
A1MP35	3030-0564		SCREW-SET 10-32 .875-IN-LG CUP-PT	28480	3030-0564
A1MP36	3050-0105	2	WASHER-FL MTLC NO.-4 .125-IN-ID	28480	3050-0105
A1MP37	3050-0105		WASHER-FL MTLC NO.-4 .125-IN-ID	28480	3050-0105
A1MP38	3050-0188	2	WASHER-SPR CRVD NO.-3/8 .385-IN-ID	78189	3502-20-19
A1MP39	3050-0274	3	WASHER-FL MTLC NO.-3/8 .39-IN-ID	28480	3050-0274
A1MP40	3050-0274		WASHER-FL MTLC NO.-3/8 .39-IN-ID	28480	3050-0274
A1MP41	3050-0274		WASHER-FL MTLC NO.-3/8 .39-IN-ID	28480	3050-0274
A1MP42	3050-0316	1	WASHER-SPR CRVD NO.-3/8 .386-IN-ID	28480	3050-0316
A1MP43	3050-0188		WASHER-SPR CRVD NO.-3/8 .385-IN-ID	28480	3050-0316
A1MP44	3130-0013	4	WASHER:SILVER PLATED 0.002" OD/ID	76854	4862-2
A1MP45	3130-0013		WASHER:SILVER PLATED 0.002" OD/ID	76854	4862-2
A1MP46	3130-0013		WASHER:SILVER PLATED 0.002" OD/ID	76854	4862-2
A1MP47	3130-0013		WASHER:SILVER PLATED 0.002" OD/ID	76854	4862-2
A1MP48	4320-0281	4	DAMPING PAD, ROUND	28480	4320-0281
A1MP49	4320-0281		DAMPING PAD, ROUND	28480	4320-0281
A1MP50	4320-0281		DAMPING PAD, ROUND	28480	4320-0281

See introduction to this section for ordering information

† FOR BACKDATING, SEE TABLE 7-1

Table 6-2. Replaceable Parts

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
A1MP51	4320-0281		DAMPING PAD, ROUND	28480	4320-0281
A1MP52	4320-0283	2	DAMPING PAD, U-CHANNEL	28480	4320-0283
A1MP53	4320-0283		DAMPING PAD, U-CHANNEL	28480	4320-0283
A1MP54	8160-0008		RFI ROUND STRIP AL .25-IN-OD	07700	20-21103
A1MP55	8160-0021		RFI ROUND STRIP BRS AG-PL .125-IN-OD	12881	10-118
A1MP56	8300-0006		BRAID, NYLON	28480	8500-0017
A1MP57	606A-102	1	ROLLER DETENT	28480	606A-102
A1MP58	606A-918	1	SPRING LEAF	28480	606A-918
A1MP59	608D-59C	1	DETENT SPRING	28480	608D-59C
A1MP60	03200-00011	1	CURSOR	28480	03200-00011
A1MP61	03200-00019	1	CONTACT	28480	03200-00019
A1MP62	03200-60018	3	PULLEY & BRACKET ASSEMBLY	28480	03200-60018
A1MP63	03200-60018		PULLEY & BRACKET ASSEMBLY	28480	03200-60018
A1MP64	03200-60018		PULLEY & BRACKET ASSEMBLY	28480	03200-60018
A1MP65	03200-60019	1	PULLEY & BRACKET ASSEMBLY	28480	03200-60019
A1MP66	08654-00003	1	CHASSIS-OSCILLATOR	28480	08654-00003
A1MP67	08654-00014	2	GASKET FEED THRU SHIELD	28480	08654-00014
A1MP68	08654-00014		GASKET FEED THRU SHIELD	28480	08654-00014
A1MP69	08654-00023	1	CLAMP BRAID	28480	08654-00023
A1MP70†	08654-00056	1	BRACKET, POT MOUNTING	28480	08654-00056
A1MP71	08654-00034	1	COVER, RF AMPLIFIER	28480	08654-00034
A1MP72	08654-00042	2	CONTACT, CAPACITOR	28480	08654-00042
A1MP73	08654-00042		CONTACT, CAPACITOR	28480	08654-00042
A1MP74	08654-20048	1	PULLEY, CAPACITOR DRIVE	28480	08654-20048
A1MP75†	08654-20091	1	PULLEY, POT DRIVE	28480	08654-20091
A1MP76	08654-20053	1	BUSHING	28480	08654-20053
A1MP77	08654-20055	1	SHAFT, FREQUENCY	28480	08654-20055
A1MP78	08654-20057	1	PLATE. FREQUENCY	28480	08654-20057
A1MP79	08654-20058	1	END PLATE, RF AMPLIFIER	28480	08654-20058
A1MP80	08654-20059	1	SHIELD, RF AMPLIFIER	28480	08654-20059
A1MP81†	08654-20021	1	DIVIDER, RF AMPLIFIER	28480	08654-20021
A1MP82	08654-20061	1	SHIELD, FEED THRU	28480	08654-20061
A1MP83	08654-20062	1	BASE PLATE, MACH	28480	08654-20062
A1MP84	08654-20063	2	GUIDE, ROD CURSOR	28480	08654-20063
A1MP85	08654-20063		GUIDE, ROD CURSOR	28480	08654-20063
A1MP86	08654-20064	1	GEAR, CENTER SHAFT M	28480	08654-20064
A1MP87	08654-20070	2	PLUG, THREADED	28480	08654-20070
A1MP88	08654-20070		PLUG, THREADED	28480	08654-20070
A1MP89	08654-20074	1	SHAFT ASSEMBLY, DIAL DRIVE	28480	08654-20074
A1MP90	08654-20076	1	COVER, RF SECTION	28480	08654-20076
A1MP91	08654-20077	1	SHAFT ASSEMBLY, COUNTER	28480	08654-20077
A1MP92	08654-20078	1	SHAFT ASSEMBLY, TURRET	28480	08654-20078
A1MP93	08654-20083	1	DRUM ASSEMBLY, DIAL	28480	08654-20083
A1MP94	3030-0001	1	SCREW-SET 8-32 .188-IN-LG SMALL CUP-PT	28480	3030-0001
A1MP95	2680-0105	4	SCREW-MACH 10-32 .625-IN-LG PAN-HD-POZI	28480	2680-0105
A1MP96	2190-0034	4	WASHER-LK HLCL NO.-10 .194-IN-ID	28480	2190-0034
A1MP97	2510-0103	2	SCREW-MACH 8-32 .375-IN-LG PAN-HD-POZI	28480	2510-0103
A1MP98	2190-0087	3	WASHER-LK HLCL NO.-8 .168-IN-ID	28480	2190-0087
A1MP99	2200-0145	2	SCREW-MACH 4-40 .438-IN-LG PAN-HD-POZI	28480	2200-0145
A1MP100	2360-0117	6	SCREW-MACH 6-32 .375-IN-LG PAN-HD-POZI	28480	2360-0117
A1MP101	2360-0115	13	SCREW-MACH 6-32 .312-IN-LG PAN-HD-POZI	28480	2360-0115
A1MP102	3050-0010	6	WASHER-FL MTLC NO.-6 .147-IN-ID	78210	65
A1MP103	3050-0066	2	WASHER-FL MTLC NO.-6 .147-IN-ID	28480	3050-0066
A1MP104	2420-0001	2	NUT-HEX-W/LKWR 6-32-THD .109-THK	28480	2420-0002
A1MP105	2360-0123	2	SCREW-MACH 6-32 .625-IN-LG PAN-HD-POZI	28480	2360-0123
A1MP106	1400-0015	1	CLAMP-CA .25-DIA .375-WD STL	73734	1550
A1MP107	2190-0014	4	WASHER-LK INTL T NO.-2 .089-IN-ID	78189	1902-00
A1MP108	0510-0060	1	RETAINER-RING .375-DIA STL CD-PL	79136	5555-37-8-MD
A1MP109	2360-0192	9	SCREW-MACH 6-32 .25-IN-LG 100 DEG	28480	2360-0192
A1MP110	2200-0153	3	SCREW-MACH 4-40 .875-IN-LG PAN-HD-POZI	28480	2200-0153
A1MP111	2200-0172	2	SCREW-MACH 4-40 .875-IN-LG 82 DEG	28480	2200-0172
A1MP112	3050-0071	1	WASHER-FL MTLC NO.-8 .169-IN-ID	28480	3050-0071
A1MP113	2510-0109		SCREW-MACH 8-32 .625-IN-LG PAN-HD-POZI	28480	2510-0109
A1MP114	2360-0121		SCREW-MACH 6-32 .5-IN-LG PAN-HD-POZI	28480	2360-0121
A1MP115	2260-0009	4	NUT-HEX-W/LKWR 4-40-THD .094-THK .25-A/F	28480	2260-0011
A1MP116	2200-0107	9	SCREW-MACH 4-40 .375-IN-LG PAN-HD-POZI	28480	2200-0107
A1MP117	2200-0101	2	SCREW-MACH 4-40 .188-IN-LG PAN-HD-POZI	28480	2200-0101
A1MP118	2950-0006	1	NUT-HEX-DBL-CHAM 1/4-32-THD .094-THK	73734	9000
A1MP119	2190-0067	1	WASHER-LK INTL T NO.-1/4 .256-IN-ID	78189	1914-05
A1MP120	3030-0007	2	SCREW-SET 4-40 .125-IN-LG SMALL CUP-PT	28480	3030-0007
A1MP121	0520-0129	1	SCREW-MACH 2-56 .312-IN-LG PAN-HD-POZI	28480	0520-0129
A1MP122	0590-0106	1	NUT-HEX-PLSTCLKG 2-56-THD .141-THK	72962	22NM-26
A1MP123	1400-0249	1	CABLE TIE .062-.625-DIA .091-WD NYL	59730	TYB-23M-8
A1MP124	1400-0024		CLAMP-CA .25-DIA .5-WD NYL	71616	CPC 1953-4A
A1MP125	2200-0113	1	SCREW-MACH 4-40 .625-IN-LG PAN-HD-POZI	28480	2200-0113

See introduction to this section for ordering information

† FOR BACKDATING, SEE TABLE 7-1.

Table 6-2. Replaceable Parts

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
A1MP126	0610-0011	1	NUT-HEX-DBL-CHAM 2-56-THD .062-THK	76854	22041-271
A1MP127	2360-0299	1	SCREW-SET 6-32 .125-IN-LG CUP-PT STL	28480	2360-0299
A1MP128	08654-00039	1	BRACKET, CAPACITOR MOUNT	28480	08654-00039
A1MP129	3030-0022	2	SCREW-SET	00000	3030-0022
A1R1	0757-0416	3	RESISTOR 511 1% .125W F TC=0+-100	24546	C4-1/8-T0-511R-F
A1R2†	2100-3649	1	RESISTOR-VAR PREC WW 3-TRN 10K 5%	28480	2100-3649
A1W1	08654-60035	1	CABLE ASSEMBLY, RF OSC OUT, (INCL A1E7)	28480	08654-60035
A1A1†	08654-60002	1	RF AMPLIFIER/ALC ASSEMBLY(EXCEPT OPT 003	28480	08654-60002
A1A1	08654-60022		RESTORED 08654-60002 OR 60102, REQUIRES EXCHANGE	28480	08654-60022
A1A1	08654-60050	1	BOARD ASSEMBLY, RF AMPLIFIER/ALC (OPTION 003 ONLY)	28480	08654-60050
A1A1	08654-60051	1	RESTORED 08654-60050,REQUIRES EXCHANGE	28480	08654-60051
A1A1C1	0160-3879	16	CAPACITOR-FXD .01UF +-20% 100WVDC CER	28480	0160-3879
A1A1C2	0160-3879		CAPACITOR-FXD .01UF +-20% 100WVDC CER	28480	0160-3879
A1A1C3	0160-3879		CAPACITOR-FXD .01UF +-20% 100WVDC CER	28480	0160-3879
A1A1C4*	0160-3565	1	CAPACITOR-FXD 6.8PF +-.5PF 100WVDC CER *FACTORY SELECTED PART	28480	0160-3565
A1A1C5	0160-3879		CAPACITOR-FXD .01UF +-20% 100WVDC CER	28480	0160-3879
A1A1C6	0160-3879		CAPACITOR-FXD .01UF +-20% 100WVDC CER	28480	0160-3879
A1A1C7	0160-3879		CAPACITOR-FXD .01UF +-20% 100WVDC CER	28480	0160-3879
A1A1C8	0160-3878	6	CAPACITOR-FXD 1000PF +-20% 100WVDC CER	28480	0160-3878
A1A1C9†	0160-2306	1	CAPACITOR-FXD 27PF +-5% 300WVDC MICA	28480	0160-2306
A1A1C10	0160-0162	1	CAPACITOR-FXD .022UF +-10% 200WVDC POLYE	56289	292P22392
A1A1C11	0160-3879		CAPACITOR-FXD .01UF +-20% 100WVDC CER	28480	0160-3879
A1A1C12	0160-3878		CAPACITOR-FXD 1000PF +-20% 100WVDC CER	28480	0160-3878
A1A1C13	0160-3879		CAPACITOR-FXD .01UF +-20% 100WVDC CER	28480	0160-3879
A1A1C14	0160-3879		CAPACITOR-FXD .01UF +-20% 100WVDC CER	28480	0160-3879
A1A1C15	0160-3879		CAPACITOR-FXD .01UF +-20% 100WVDC CER	28480	0160-3879
A1A1C16	0160-3877	1	CAPACITOR-FXD 100PF +-20% 200WVDC CER	28480	0160-3877
A1A1C17	0160-3879		CAPACITOR-FXD .01UF +-20% 100WVDC CER	28480	0160-3879
A1A1C18	0160-3879		CAPACITOR-FXD .01UF +-20% 100WVDC CER	28480	0160-3879
A1A1C19	0160-3873	1	CAPACITOR-FXD 4.7PF +-.5PF 200WVDC CER	28480	0160-3873
A1A1C20	0160-3875	2	CAPACITOR-FXD 22PF +-5% 200WVDC CER	28480	0160-3875
A1A1C21	0160-3878		CAPACITOR-FXD 1000PF +-20% 100WVDC CER	28480	0160-3878
A1A1C22	0160-3879		CAPACITOR-FXD .01UF +-20% 100WVDC CER	28480	0160-3879
A1A1C23	0160-3876	1	CAPACITOR-FXD 47PF +-20% 200WVDC CER	28480	0160-3876
A1A1C24	0160-3875		CAPACITOR-FXD 22PF +-5% 200WVDC CER	28480	0160-3875
A1A1C25	0160-3878		CAPACITOR-FXD 1000PF +-20% 100WVDC CER	28480	0160-3878
A1A1CR1	1901-0040	17	DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A1A1CR2	1901-0747	2	DIODE-PIN	28480	1901-0747
A1A1CR3	1901-0747		DIODE-PIN	28480	1901-0747
A1A1CR4	1901-0535	4	DIODE-SCHOTTKY	28480	1901-0535
A1A1CR5	1901-0535		DIODE-SCHOTTKY	28480	1901-0535
A1A1J1	1250-1220	3	CONNECTOR-RF SMC M PC	98291	50-051-0109
A1A1J2	1250-1220		CONNECTOR-RF SMC M PC	98291	50-051-0109
A1A1J3	1250-1220		CONNECTOR-RF SMC M PC	98291	50-051-0109
A1A1L1	9140-0114		COIL-MLD 10UH 10% Q=55 .155DX.375LG	99800	1537-36
A1A1L2	9100-2252	1	COIL-FXD MOLDED RF CHOKE .27UH 10%	24226	10/270
A1A1L3	08654-80001	1	INDUCTOR, RF 15 NH	28480	08654-80001
A1A1L4	08654-80003	1	INDUCTOR, RF 45 NH	28480	08654-80003
A1A1L5	9100-1623	1	COIL-MLD 27UH 5% Q=60 .155DX.375LG	24226	15/272
A1A1L6	08654-80002	1	INDUCTOR, RF 35 NH	28480	08654-80002
A1A1L7	9100-2247	1	COIL-FXD MOLDED RF CHOKE .1UH 10%	24226	10/100
A1A1MP1	0340-0008	1	TERMINAL-STUD DBL-TUR PRESS-MTG	98291	ST-1000-L2
A1A1MP2	08654-00019	1	SHIELD, BUFFER AMPLIFIER	28480	08654-00019
A1A1MP3	08654-00020	1	SHIELD, MODULATOR	28480	08654-00020
A1A1MP4	08654-00021	1	GROUND STRAP	28480	08654-00021
A1A1MP5	08654-00055	1	LABEL,BD IDENTIFICATION (OPT 003 ONLY)	28480	08654-00055
A1A1Q1	1854-0696	5	TRANSISTOR NPN SI TO-72 PD=200MW	28480	1854-0696
	1205-0037		HEAT SINK TO-36-PKG	28480	1205-0037
A1A1Q2	1855-0020	1	TRANSISTOR J-FET N-CHAN D-MODE TO-18 SI	28480	1855-0020
A1A1Q3	1854-0696		TRANSISTOR NPN SI TO-72 PD=200MW	28480	1854-0696
	1205-0037		HEAT SINK TO-36-PKG	28480	1205-0037
A1A1Q4	5086-4218	4	HP-21 TO 72 PKG	28480	5086-4218
	1205-0037		HEAT SINK TO-36-PKG	28480	1205-0037
A1A1Q5	1854-0696		TRANSISTOR NPN SI TO-72 PD=200MW	28480	1854-0696
	1205-0037		HEAT SINK TO-36-PKG	28480	1205-0037
A1A1Q6	5086-4218		HP-21 TO-72 PKG (OPT 003 ONLY)	28480	5086-4218
A1A1Q6	1854-0696		TRANSISTOR NPN SI TO-72 PD=200MW (EXCEPT OPTION 003)	28480	1854-0696
	1205-0037		HEAT SINK TO-36-PKG	28480	1205-0037
A1A1Q7	5086-4218		HP-21 TO-72 PKG (OPT 003 ONLY)	28480	5086-4218
A1A1Q7	1854-0696		TRANSISTOR NPN SI TO-72 PD=200MW (EXCEPT OPTION 003)	28480	1854-0696
	1205-0037		HEAT SINK TO-36-PKG	28480	1205-0037
A1A1Q8	1853-0020	1	TRANSISTOR PNP SI PD=300MW FT=150MHZ	28480	1853-0020

See introduction to this section for ordering information

† FOR BACKDATING, SEE TABLE 7-1.

Table 6-2. Replaceable Parts

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
A1A1Q9	1854-0071	3	TRANSISTOR NPN SI PD=300MW FT=200MHZ	28480	1854-0071
A1A1R1*	0698-7216	4	RESISTOR 147 1% .05W F TC=0+-100 *FACTORY SELECTED PART	24546	C3-1/8-T0-147R-G
A1A1R2	0698-7208	2	RESISTOR 68.1 1% .05W F TC=0+-100	24546	C3-1/8-T00-68R1-G
A1A1R3	0698-7232	1	RESISTOR 681 1% .05W F TC=0+-100	24546	C3-1/8-T0-681R-G
A1A1R4	0698-7284	3	RESISTOR 100K 1% .05W F TC=0+-100	24546	C3-1/8-T0-1003-G
A1A1R5	0698-7227	1	RESISTOR 422 1% .05W F TC=0+-100	24546	C3-1/8-T0-422R-G
A1A1R6	0698-7205	2	RESISTOR 51.1 1% .05W F TC=0+-100	24546	C3-1/8-T00-51R1-G
A1A1R7	0698-7196	1	RESISTOR 21.5 2% .05W F TC=0+-100	24546	C3-1/8-T00-21R5-G
A1A1R8	0698-7253	3	RESISTOR 5.11K 1% .05W F TC=0+-100	24546	C3-1/8-T0-5111-G
A1A1R9	0698-7229	2	RESISTOR 511 1% .05W F TC=0+-100	24546	C3-1/8-T0-511R-G
A1A1R10	0698-7253		RESISTOR 5.11K 1% .05W F TC=0+-100	24546	C3-1/8-T0-5111-G
A1A1R11	0698-7222	1	RESISTOR 261 1% .05W F TC=0+-100	24546	C3-1/8-T0-261R-G
A1A1R12	0698-7224	1	RESISTOR 316 1% .05W F TC=0+-100	24546	C3-1/8-T0-316R-G
A1A1R13	0698-7214	2	RESISTOR 121 1% .05W F TC=0+-100	24546	C3-1/8-T0-121R-G
A1A1R14	0698-7188	5	RESISTOR 10 1% .05W F TC=0+-100	24546	C3-1/8-T00-10R-G
A1A1R15*	0698-7207	1	RESISTOR 61.9 1% .05W F TC=0+-100 *FACTORY SELECTED PART	24546	C3-1/8-T00-61R9-G
A1A1R16	0698-7205		RESISTOR 51.1 1% .05W F TC=0+-100	24546	C3-1/8-T00-51R1-G
A1A1R17	0698-7284		RESISTOR 100K 1% .05W F TC=0+-100	24546	C3-1/8-T0-1003-G
A1A1R18	0757-0814	1	RESISTOR 511 1% .5W F TC=0+-100	19701	MF7C1/2-T0-511R-F
A1A1R19	0698-7239	1	RESISTOR 1.33K 1% .05W F TC=0+-100	24546	C3-1/8-T0-1331-G
A1A1R20	0698-7247	1	RESISTOR 2.87K 1% .05W F TC=0+-100	24546	C3-1/8-T0-2871-G
A1A1R21	0698-7214		RESISTOR 121 1% .05W F TC=0+-100	24546	C3-1/8-T0-121R-G
A1A1R22	0698-3444	3	RESISTOR 316 1% .125W F TC=0+-100	24546	C4-1/8-T0-316R-F
A1A1R23	0698-7198	2	RESISTOR 26.1 1% .05W F TC=0+-100	24546	C3-1/8-T00-26R1-G
A1A1R24	0698-7217	1	RESISTOR 162 1% .05W F TC=0+-100	24546	C3-1/8-T0-162R-G
A1A1R25	0698-7198		RESISTOR 26.1 1% .05W F TC=0+-100	24546	C3-1/8-T00-26R1-G
A1A1R26	0698-7284		RESISTOR 100K 1% .05W F TC=0+-100	24546	C3-1/8-T0-1003-G
A1A1R27	0698-7188		RESISTOR 10 1% .05W F TC=0+-100	24546	C3-1/8-T00-10R-G
A1A1R28*	0698-7220	1	RESISTOR 215 1% .05W F TC=0+-100 *FACTORY SELECTED PART	24546	C3-1/8-T0-215R-G
A1A1R29	0698-7256	1	RESISTOR 6.81K 1% .05W F TC=0+-100	24546	C3-1/8-T0-6811-G
A1A1R30	0698-7195	1	RESISTOR 19.6 1% .05W F TC=0+-100	24546	C3-1/8-T00-19R6-G
A1A1R31*	0698-7212	1	RESISTOR 100 1% .05W F TC=0+-100 *FACTORY SELECTED PART	24546	C3-1/8-T0-100R-G
A1A1R32	0698-7253		RESISTOR 5.11K 1% .05W F TC=0+-100	24546	C3-1/8-T0-5111-G
A1A1R33	0698-7279	1	RESISTOR 61.9K 1% .05W F TC=0+-100	24546	C3-1/8-T0-6192-G
A1A1R34	0698-7286	1	RESISTOR 121K 1% .05W F TC=0+-100	24546	C3-1/8-T0-1213-G
A1A1R35	0698-7201	1	RESISTOR 34.8 1% .05W F TC=0+-100	24546	C3-1/8-T00-34R8-G
A1A1R36	0698-7248	5	RESISTOR 3.16K 1% .05W F TC=0+-100	24546	C3-1/8-T0-3161-G
A1A1R37	0698-7269	1	RESISTOR 23.7K 1% .05W F TC=0+-100	24546	C3-1/8-T0-2372-G
A1A1R38	0698-7245	1	RESISTOR 2.37K 1% .05W F TC=0+-100	24546	C3-1/8-T0-2371-G
A1A1R39	2100-2497	2	RESISTOR-TRMR 2K 10% C TOP-ADJ 1-TRN	73138	62-207-1
A1A1TP1	0360-0124	5	TERMINAL-STUD SGL-PIN PRESS-MTG	28480	0360-0124
A1A1TP2	0360-0124		TERMINAL-STUD SGL-PIN PRESS-MTG	28480	0360-0124
A1A1TP3	0360-0124		TERMINAL-STUD SGL-PIN PRESS-MTG	28480	0360-0124
A1A1TP4	0360-0124		TERMINAL-STUD SGL-PIN PRESS-MTG	28480	0360-0124
A1A1TP5	0360-0124		TERMINAL-STUD SGL-PIN PRESS-MTG	28480	0360-0124
A1A1U1	1826-0013	5	IC 741 OP AMP	28480	1826-0013
A1A2	08654-60104	1	BOARD ASSEMBLY, FM MODULATOR	28480	08654-60104
A1A2C1	0160-3872	2	CAPACITOR-FXD 2.2PF +-.25PF 200WVDC CER	28480	0160-3872
A1A2C2	0160-4289	2	CAPACITOR-FXD 15PF +-5% 100WVDC CER	95275	VK25BA150J
A1A2C3	0160-4289		CAPACITOR-FXD 15PF +-5% 100WVDC CER	95275	VK25BA150J
A1A2C4	0160-3872		CAPACITOR-FXD 2.2PF +-.25PF 200WVDC CER	28480	0160-3872
A1A2CR1	0122-0245	2	DIODE-VVC 1N5139 6.8PF 10%	04713	1N5139
A1A2CR2	0122-0245		DIODE-VVC 1N5139 6.8PF 10%	04713	1N5139
A1A2L1			NSR, P/O ETCHED CIRCUIT BOARD		
A1A2L2			NSR, P/O ETCHED CIRCUIT BOARD		
A1A2MP1	08654-00040	1	BRACKET, FM MODULATOR BOARD	28480	08654-00040
A1A2R1	0698-7260	6	RESISTOR 10K 1% .05W F TC=0+-100	24546	C3-1/8-T0-1002-G
A1A2R2	0698-7260		RESISTOR 10K 1% .05W F TC=0+-100	24546	C3-1/8-T0-1002-G
A1A2R3	0698-7260		RESISTOR 10K 1% .05W F TC=0+-100	24546	C3-1/8-T0-1002-G
A1A3	08654-60003	1	BOARD ASSEMBLY, RF OSCILLATOR	28480	08654-60003
A1A3C1	0180-0116	3	CAPACITOR-FXD 6.8UF+-10% 35VDC TA	56289	150D685X903582
A1A3C2	0121-0447	1	CAPACITOR-V TRMR-CER 1.5/2.5PF 63V	00868	59-TRIKO-04 1.5-2.5 PF-P100
A1A3C3	0160-0682	2	CAPACITOR-FXD 3.3PF +-.5PF 200WVDC CER	28480	0160-0682
A1A3C4	0160-0682		CAPACITOR-FXD 3.3PF +-.5PF 200WVDC CER	28480	0160-0682
A1A3C5	0160-3879		CAPACITOR-FXD .01UF +-20% 100WVDC CER	28480	0160-3879

See introduction to this section for ordering information

Table 6-2. Replaceable Parts

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
A1A3C6*	0160-2248	1	CAPACITOR-FXD 4.3PF +-.25PF 500WVDC CER *FACTORY SELECTED PART	28480	0160-2248
A1A3C7	0160-3879		CAPACITOR-FXD .01UF +-20% 100WVDC CER	28480	0160-3879
A1A3C8	0160-3878		CAPACITOR-FXD 1000PF +-20% 100WVDC CER	28480	0160-3878
A1A3C9	0160-0174	1	CAPACITOR-FXD .47UF +80-20% 25WVDC CER	28480	0160-0174
A1A3C10	0160-3879		CAPACITOR-FXD .01UF +-20% 100WVDC CER	28480	0160-3879
A1A3C11	0160-3878		CAPACITOR-FXD 1000PF +-20% 100WVDC CER	28480	0160-3878
A1A3C12*	0160-2236	1	CAPACITOR-FXD 1PF +-.25PF 500WVDC CER *FACTORY SELECTED PART	28480	0160-2236
A1A3CR1	1901-0535		DIODE-SCHOTTKY	28480	1901-0535
A1A3CR2	1901-0535		DIODE-SCHOTTKY	28480	1901-0535
A1A3J1	1250-0835	1	CONNECTOR-RF SMC M PC 50-OHM	98291	50-051-0000
A1A3Q1	1854-0345	2	TRANSISTOR NPN 2N5179 SI TO-72 PD=200MW	04713	2N5179
A1A3Q2	1854-0345		TRANSISTOR NPN 2N5179 SI TO-72 PD=200MW	04713	2N5179
A1A3Q3	5086-4218		HP-21 TO TO-72 PKG	28480	5086-4218
	1205-0037	7	HEAT SINK TO-36-PKG	28480	1205-0037
A1A3Q4	1854-0404	3	TRANSISTOR NPN SI TO-18 PD=360MW	28480	1854-0404
A1A3Q5	1854-0404		TRANSISTOR NPN SI TO-18 PD=360MW	28480	1854-0404
A1A3Q6	1854-0404		TRANSISTOR NPN SI TO-18 PD=360MW	28480	1854-0404
A1A3R1	0698-7216		RESISTOR 147 1% .05W F TC=0+-100	24546	C3-1/8-T0-147R-G
A1A3R2	0698-7236	2	RESISTOR 1K 1% .05W F TC=0+-100	24546	C3-1/8-T0-1001-G
A1A3R3	0698-7236		RESISTOR 1K 1% .05W F TC=0+-100	24546	C3-1/8-T0-1001-G
A1A3R4	0698-7248		RESISTOR 3.16K 1% .05W F TC=0+-100	24546	C3-1/8-T0-3161-G
A1A3R5	0698-7260		RESISTOR 10K 1% .05W F TC=0+-100	24546	C3-1/8-T0-1002-G
A1A3R6	0698-7216		RESISTOR 147 1% .05W F TC=0+-100	24546	C3-1/8-T0-147R-G
A1A3R7	0698-7188		RESISTOR 10 1% .05W F TC=0+-100	24546	C3-1/8-T00-10R-G
A1A3R8	0698-7260		RESISTOR 10K 1% .05W F TC=0+-100	24546	C3-1/8-T0-1002-G
A1A3R9	0698-7248		RESISTOR 3.16K 1% .05W F TC=0+-100	24546	C3-1/8-T0-3161-G
A1A3R10	0698-7248		RESISTOR 3.16K 1% .05W F TC=0+-100	24546	C3-1/8-T0-3161-G
A1A3R11	0698-7228	1	RESISTOR 464 1% .05W F TC=0+-100	24546	C3-1/8-T0-464R-G
A1A3R12	0698-7248		RESISTOR 3.16K 1% .05W F TC=0+-100	24546	C3-1/8-T0-3161-G
A1A3R13	0698-7188		RESISTOR 10 1% .05W F TC=0+-100	24546	C3-1/8-T00-10R-G
A1A3R14	0698-7208		RESISTOR 68.1 1% .05W F TC=0+-100	24546	C3-1/8-T00-68R1-G
A1A3R15	0698-7216		RESISTOR 147 1% .05W F TC=0+-100	24546	C3-1/8-T0-147R-G
A1A3R16	0698-7230	1	RESISTOR 562 1% .05W F TC=0+-100	24546	C3-1/8-T0-562R-G
A1A3R17	0698-3260	2	RESISTOR 464K 1% .125W F TC=0+-100	91637	CMF-55-1, T-1
A1A3R18	0698-7188		RESISTOR 10 1% .05W F TC=0+-100	24546	C3-1/8-T00-10R-G
A1A3R19	0698-7204	1	RESISTOR 46.4 1% .05W F TC=0+-100	24546	C3-1/8-T00-46R4-G
A1A3R20	0698-7260		RESISTOR 10K 1% .05W F TC=0+-100	24546	C3-1/8-T0-1002-G
A1A3R21	0698-7229		RESISTOR 511 1% .05W F TC=0+-100	24546	C3-1/8-T0-511R-G
A1A4	08654-60021	1	TURRET ASSEMBLY	28480	08654-60021
A1A4E1	9170-0847	3	CORE-SHIELDING BEAD	02114	56-590-65/3B PARYLENE COATED
A1A4E2	9170-0847		CORE-SHIELDING BEAD	02114	56-590-65/3B PARYLENE COATED
A1A4E3	9170-0847		CORE-SHIELDING BEAD	02114	56-590-65/3B PARYLENE COATED
A1A4R1	0686-1015	5	RESISTOR 100 5% .5W CC TC=0+529	01121	EB1015
A1A4R2	0686-1015		RESISTOR 100 5% .5W CC TC=0+529	01121	EB1015
A1A4R3	0686-1015		RESISTOR 100 5% .5W CC TC=0+529	01121	EB1015
A1A4R4	0686-1015		RESISTOR 100 5% .5W CC TC=0+529	01121	EB1015
A1A4R5	0686-1015		RESISTOR 100 5% .5W CC TC=0+529	01121	EB1015
A1A5	08654-60028	1	SWITCH ASSEMBLY, ROTARY P.C.	28480	08654-60028
A1A5J1			NSR, P/O A1A5.		
A1A5J2			NSR, P/O A1A5.		
A1A5MP1	08654-00054	1	LABEL, CONNECTOR	28480	08654-00054
A1A5MP2	3050-0161	1	WASHER-SPR WAVY 1/4" .265"ID	04426	R-2
A1A5MP3	0510-0005	1	RETAINER, RING BSC EXT .25" DIA STL	28480	0510-0005
A1A5MP4	3050-0017	4	WASHER-FLAT MTLC 1/4" .26" ID	28480	3050-0017
A1A5W1			NSR, P/O A1A5.		
A1A5W2			NSR, P/O A1A5.		
A2	08654-60024	1	ATTENUATOR ASSEMBLY(INCL A2J1 AND A2J2) NOT RECOMMENDED FOR FIELD REPAIR	28480	08654-60024
A2	08654-60023		RESTORED 08654-60024, REQUIRES EXCHANGE	28480	08654-60023
A2J1			NSR, P/O A2		
A2J2			NSR, P/O A2		
A3	08654-60101	1	BOARD ASSEMBLY, CONTROL/POWER SUPPLY	28480	08654-60101
A3C1	0160-2055	8	CAPACITOR-FXD .01UF +80-20% 100WVDC CER	28480	0160-2055
A3C2	0160-2055		CAPACITOR-FXD .01UF +80-20% 100WVDC CER	28480	0160-2055
A3C3	0160-2055		CAPACITOR-FXD .01UF +80-20% 100WVDC CER	28480	0160-2055
A3C4	0160-2055		CAPACITOR-FXD .01UF +80-20% 100WVDC CER	28480	0160-2055
A3C5	0160-2055		CAPACITOR-FXD .01UF +80-20% 100WVDC CER	28480	0160-2055

See introduction to this section for ordering information

Table 6-2. Replaceable Parts

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
A3C6	0160-2055		CAPACITOR-FXD .01UF +80-20% 100WVDC CER	28480	0160-2055
A3C7	0160-2055		CAPACITOR-FXD .01UF +80-20% 100WVDC CER	28480	0160-2055
A3C8	0160-2055		CAPACITOR-FXD .01UF +80-20% 100WVDC CER	28480	0160-2055
A3C9	0180-2181	2	CAPACITOR-FXD 1300UF+75-10% 50VDC AL	56289	36D132G050AA2A
A3C10	0180-2181		CAPACITOR-FXD 1300UF+75-10% 50VDC AL	56289	36D132G050AA2A
A3C11	0180-0049		CAPACITOR-FXD 20UF+75-10% 50VDC AL	56289	30D206G050CC2
A3C12	0180-0116		CAPACITOR-FXD 6.8UF+-10% 35VDC TA	56289	150D685X903582
A3C13	0160-0161	1	CAPACITOR-FXD .01UF +-10% 200WVDC POLYE	56289	292P10392
A3C14	0180-0116		CAPACITOR-FXD 6.8UF+-10% 35VDC TA	56289	150D685X903582
A3C15	0160-3460	1	CAPACITOR-FXD .05UF +80-20% 100WVDC CER	28480	0160-3460
A3C16	0160-2194	1	CAPACITOR-FXD .18UF +-5% 200WVDC POLYE	28480	0160-2194
A3C17	0160-3456	1	CAPACITOR-FXD 1000PF +-10% 1000WVDC CER	28480	0160-3456
A3C18	0180-2206	1	CAPACITOR-FXD 60UF+-10% 6VDC TA	56289	150D606X900682
A3C19	0160-2204	1	CAPACITOR-FXD 100PF +-5% 300WVDC MICA	28480	0160-2204
A3C20	0160-0300	1	CAPACITOR-FXD 2700PF +-10% 200WVDC POLYE	56289	292P27292
A3C21	0180-0291	4	CAPACITOR-FXD 1UF+-10% 35VDC TA	56289	150D105X9035A2
A3C22	0160-3534	1	CAPACITOR-FXD 510PF +-5% 100WVDC MICA	28480	0160-3534
A3C23*†	0140-0195	1	CAPACITOR-FXD 130PF +-5% 300WVDC MICA *FACTORY SELECTED PART	04522	DM15F131J0300WV1CR
A3C24	0160-2257	2	CAPACITOR-FXD 10PF +-5% 500WVDC CER	28480	0160-2257
A3C25	0180-0228	1	CAPACITOR-FXD 22UF+-10% 15VDC TA	56289	150D226X901582
A3C26	0180-0291		CAPACITOR-FXD 1UF+-10% 35VDC TA	56289	150D105X9035A2
A3C27	0160-2201	5	CAPACITOR-FXD 51PF +-5% 300WVDC MICA	28480	0160-2201
A3C28	0180-0049		CAPACITOR-FXD 20UF+75-10% 50VDC AL	56289	30D206G050CC2
A3C29	0180-0089		CAPACITOR-FXD 10UF+50-10% 150VDC AL	56289	30D106F150DD2
A3CR1	1901-0364	2	DIODE-FW BRDG 200V 1A	04713	SDA 10185-4
A3CR2	1901-0364		DIODE-FW BRDG 200V 1A	04713	SDA 10185-4
A3CR3	1901-0040		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A3CR4	1901-0040		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A3CR5	1901-0040		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A3CR6	1901-0040		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A3CR7	1901-0040		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A3CR8	1901-0040		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A3CR9	1901-0040		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A3CR10	1901-0040		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A3CR11	1901-0040		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A3CR12	1901-0040		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A3CR13	1901-0040		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A3CR14	1901-0040		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A3CR15	1901-0040		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A3CR16	1901-0040		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A3CR17	1901-0040		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A3CR18	1901-0040		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A3MP1	0360-1514	40	TERMINAL-STUD SGL-PIN PRESS-MTG	28480	0360-1514
A3MP2	0360-1514		TERMINAL-STUD SGL-PIN PRESS-MTG	28480	0360-1514
A3MP3	0360-1514		TERMINAL-STUD SGL-PIN PRESS-MTG	28480	0360-1514
A3Q1	1854-0072	2	TRANSISTOR NPN 2N3054 SI TO-66 PD=25W	02735	2N3054
	08654-20031	1	HEAT SINK, TO-66	28480	08654-20031
A3Q2	1853-0012	1	TRANSISTOR PNP 2N2904A SI TO-5 PD=600MW	01295	2N2904A
A3Q3	1854-0071		TRANSISTOR NPN SI PD=300MW FT=200MHZ	28480	1854-0071
A3Q4	1854-0071		TRANSISTOR NPN SI PD=300MW FT=200MHZ	28480	1854-0071
A3Q5	1854-0072		TRANSISTOR NPN 2N3054 SI TO-66 PD=25W	02735	2N3054
A3Q6	1854-0022	2	TRANSISTOR NPN SI TO-39 PD=700MW	07263	S17843
A3R1	0757-0278		RESISTOR 1.78K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1781-F
A3R2	0757-0442	18	RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A3R3	0757-0438	1	RESISTOR 5.11K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5111-F
A3R4	0757-0290	2	RESISTOR 6.19K 1% .125W F TC=0+-100	19701	MF4C1/8-T0-6191-F
A3R5	2100-1758	1	RESISTOR-TRMR 1K 5% WW SIDE-ADJ 1-TURN	GB027	CT-106-4
A3R6	0698-3156	3	RESISTOR 14.7K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1472-F
A3R7†	0683-0275	2	RESISTOR 2.7 5% .25W FC TC=-400/+500	01121	CB27G5
A3R8	0698-3633	1	RESISTOR 390 5% 2W MO TC=0+-200	11502	RG42
A3R9	0683-0475	1	RESISTOR 4.7 5% .25W FC TC=-400/+500	01121	CB47G5
A3R10	0757-0394	2	RESISTOR 51.1 1% .125W F TC=0+-100	24546	C4-1/8-T0-51R1-F
A3R11	0698-3444		RESISTOR 316 1% .125W F TC=0+-100	24546	C4-1/8-T0-316R-F
A3R12	0757-0280	3	RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A3R13	0757-0442		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A3R14	0757-0465	9	RESISTOR 100K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1003-F
A3R15	0683-0275		RESISTOR 2.7 5% .25W FC TC=-400/+500	01121	CB27G5
A3R16	0811-2816	1	RESISTOR 1.8 5% .75W PW TC=0+-50	91637	RS-1/2
A3R17	0698-3628	1	RESISTOR 220 5% 2W MO TC=0+-200	11502	RG42
A3R18	0757-0442		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A3R19	0698-3440	1	RESISTOR 196 1% .125W F TC=0+-100	24546	C4-1/8-T0-196R-F
A3R20	0698-3444		RESISTOR 316 1% .125W F TC=0+-100	24546	C4-1/8-T0-316R-F

See introduction to this section for ordering information

† FOR BACKDATING, SEE TABLE 7-1.

Table 6-2. Replaceable Parts

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
A3R21	0757-0464	3	RESISTOR 90.9K 1% .125W F TC=0+-100	24546	C4-1/8-T0-9092-F
A3R22	0757-0463	1	RESISTOR 82.5K 1% .125W F TC=0+-100	24546	C4-1/8-T0-8252-F
A3R23	0698-3457	3	RESISTOR 316K 1% .125W F TC=0+-100	91637	CMF-55-1, T-1
A3R24	0757-0280		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A3R25	0757-0441		RESISTOR 8.25K 1% .125W F TC=0+-100	24546	C4-1/8-T0-8251-F
A3R26	0757-0442		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A3R27	0757-0458	6	RESISTOR 51.1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5112-F
A3R28	0698-3161	2	RESISTOR 38.3K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3832-F
A3R29	0698-3158	3	RESISTOR 23.7K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2372-F
A3R30	0757-0442		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A3R31	0757-0394		RESISTOR 51.1 1% .125W F TC=0+-100	24546	C4-1/8-T0-51R1-F
A3R32	0757-0442		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A3R33	0698-3154	1	RESISTOR 4.22K 1% .125W F TC=0+-100	24546	C4-1/8-T0-4221-F
A3R34	2100-2489	1	RESISTOR-TRMR 5K 10% C SIDE-ADJ 1-TRN	19701	ET50X502
A3R35	0757-0447		RESISTOR 16.2K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1622-F
A3R36	0698-3458	3	RESISTOR 348K 1% .125W F TC=0+-100	91637	CMF-55-1, T-1
A3R37	0698-3162	2	RESISTOR 46.4K 1% .125W F TC=0+-100	24546	C4-1/8-T0-4642-F
A3R38	0757-0279	2	RESISTOR 3.16K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3161-F
A3R39	0757-0416		RESISTOR 511 1% .125W F TC=0+-100	24546	C4-1/8-T0-511R-F
A3R40	0757-0465		RESISTOR 100K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1003-F
A3R41	0757-0461	1	RESISTOR 68.1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-6812-F
A3R42	0698-3459	2	RESISTOR 383K 1% .125W F TC=0+-100	91637	CMF-55-1, T-1
A3R43	0757-0280		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A3R44	0757-0462	1	RESISTOR 75K 1% .125W F TC=0+-100	24546	C4-1/8-T0-7502-F
A3R45	2100-2517	1	RESISTOR-TRMR 50K 10% C SIDE-ADJ 1-TRN	30983	ET50X503
A3R46	0698-3260		RESISTOR 464K 1% .125W F TC=0+-100	91637	CMF-55-1, T-1
A3R47	0757-0465		RESISTOR 100K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1003-F
A3R48	0757-0442		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A3R49	0698-3454	1	RESISTOR 215K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2153-F
A3R50	0757-0442		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A3R51	0757-0180	1	RESISTOR 31.6 1% .125W F TC=0+-100	24546	C4, T-0
A3R52	2100-2516	2	RESISTOR-TRMR 100K 10% C SIDE-ADJ 1-TRN	73138	62-231-1
A3R53*	0698-4424	1	RESISTOR 1.4K 1% .125W F TC=0+-100 *FACTORY SELECTED PART	24546	C4-1/8-T0-1401-F
A3R54	2100-2516		RESISTOR-TRMR 100K 10% C SIDE-ADJ 1-TRN	73138	62-231-1
A3R55	0683-2265	1	RESISTOR 22M 5% .25W FC TC=-900/+1200	01121	CB2265
A3R56	0757-0465		RESISTOR 100K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1003-F
A3R57	2100-2514	1	RESISTOR-TRMR 20K 10% C SIDE-ADJ 1-TRN	30983	ET50W203
A3R58	0698-3450	1	RESISTOR 42.2K 1% .125W F TC=0+-100	24546	C4-1/8-T0-4222-F
A3R59	0757-0279		RESISTOR 3.16K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3161-F
A3R60†	0698-3155	1	RESISTOR 4.64K 1% .125W F TC=0+-100	24546	C4-1/8-T0-4641-F
A3R61	0757-0447		RESISTOR 16.2K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1622-F
A3R62	0757-0288		RESISTOR 9.09K 1% .125W F TC=0+-100	19701	MF4C1/8-T0-9091-F
A3R63	0757-0458		RESISTOR 51.1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5112-F
A3S1	3101-0973	1	SWITCH-SL DPDT-NS MINTR .5A 125VAC/DC PC	79727	GF126-0018
A3TP1-13	0360-1514		TERMINAL-STUD SGL-PIN PRESS-MTG	28480	0360-1514
A3U1	1820-0223	1	IC LM 301A OP AMP	27014	LM301AH
A3U2	1826-0013		IC 741 OP AMP	28480	1826-0013
A3U3	1826-0288	1	IC CA 1458 OP AMP	28480	1826-0288
A3U4	1826-0092	4	IC MC 1458 OP AMP	28480	1826-0092
A3U5	1826-0013		IC 741 OP AMP	28480	1826-0013
A3U6	1826-0013		IC 741 OP AMP	28480	1826-0013
A3VR1	1902-0680	1	DIODE-ZNR 1N827 6.2V 5% DO-7 PD=.25W	03877	1N827
A3VR2	1902-0041	1	DIODE-ZNR 5.11V 5% DO-7 PD=.4W TC=-.009%	15818	CD 35622
A3VR3	1902-0049	1	DIODE-ZNR 6.19V 5% DO-7 PD=.4W TC=+.022%	28480	1902-0049
A4	0960-0444	1	LINE MODULE(INCLUDES A4J1, A4P1).	28480	0960-0444
A4J1			CONNECTOR, NSR, P/O A4		
A4P1	5020-8157	1	CARD, VOLTAGE SELECT (SEE SECTION II)	28480	5020-8157
A5	08654-60106	1	BOARD ASSEMBLY, FM DRIVER	28480	08654-60106
A5C1	0160-3447	1	CAPACITOR-FXD 470PF +-10% 1000WVDC CER	28480	0160-3447
A5C2	0160-3467	4	CAPACITOR-FXD 100PF +-10% 1000WVDC CER	28480	0160-3467
A5C3	0160-2201		CAPACITOR-FXD 51PF +-5% 300WVDC MICA	28480	0160-2201
A5C4	0160-3467		CAPACITOR-FXD 100PF +-10% 1000WVDC CER	28480	0160-3467
A5C5	0160-3467		CAPACITOR-FXD 100PF +-10% 1000WVDC CER	28480	0160-3467
A5C6	0160-2201		CAPACITOR-FXD 51PF +-5% 300WVDC MICA	28480	0160-2201
A5C7	0160-4084	5	CAPACITOR-FXD .1UF +-20% 50WVDC CER	28480	0160-4084
A5C8	0160-3467		CAPACITOR-FXD 100PF +-10% 1000WVDC CER	28480	0160-3467
A5C9	0180-0374	1	CAPACITOR-FXD 10UF+-10% 20VDC TA	56289	150D106X902082
A5C10	0160-4084		CAPACITOR-FXD .1UF +-20% 50WVDC CER	28480	0160-4084

See introduction to this section for ordering information

† FOR BACKDATING, SEE TABLE 7-1.

Table 6-2. Replaceable Parts

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
A5C11	0180-0058	4	CAPACITOR-FXD 50UF+75-10% 25VDC AL	56289	30D506G025CC2
A5C12	0180-0058		CAPACITOR-FXD 50UF+75-10% 25VDC AL	56289	30D506G025CC2
A5C13	0160-4084		CAPACITOR-FXD .1UF +-20% 50WVDC CER	28480	0160-4084
A5C14	0160-2264	1	CAPACITOR-FXD 20PF +-5% 500WVDC CER	28480	0160-2264
A5C15	0160-4084		CAPACITOR-FXD .1UF +-20% 50WVDC CER	28480	0160-4084
A5C16	0180-0291		CAPACITOR-FXD 1UF+-10% 35VDC TA	56289	150D105X9035A2
A5C17	0180-0291		CAPACITOR-FXD 1UF+-10% 35VDC TA	56289	150D105X9035A2
A5C18	0160-4084		CAPACITOR-FXD .1UF +-20% 50WVDC CER	28480	0160-4084
A5C19	0180-0058		CAPACITOR-FXD 50UF+75-10% 25VDC AL	56289	30D506G025CC2
A5C20	0180-0058		CAPACITOR-FXD 50UF+75-10% 25VDC AL	56289	30D506G025CC2
A5C21	0140-0210	1	CAPACITOR-FXD 270PF +-5% 300WVDC MICA	72136	DM15F271J0300WV1CR
A5C22	0180-0100	1	CAPACITOR-FXD 4.7UF+-10% 35VDC TA	56289	150D475X9035B2
A5C23	0160-2205	1	CAPACITOR-FXD 120PF +-5% 300WVDC MICA	28480	0160-2205
A5C24	0160-2257		CAPACITOR-FXD 10PF +-5% 500WVDC CER	28480	0160-2257
A5C25	0160-0157	1	CAPACITOR-FXD 4700PF +-10% 200WVDC POLYE	56289	292P47292
A5C26	0180-0089		CAPACITOR-FXD 10UF+50-10% 150VDC AL	56289	30D106F150DD2
A5C27	0140-0198	1	CAPACITOR-FXD 200PF +-5% 300WVDC MICA	72136	DM15F201J0300WV1CR
A5C28	0160-2201		CAPACITOR-FXD 51PF +-5% 300WVDC MICA	28480	0160-2201
A5C29	0160-2201		CAPACITOR-FXD 51PF +-5% 300WVDC MICA	28480	0160-2201
A5CR1	1901-1011	2	DIODE-ARRAY 5MV	28480	1901-1011
A5CR2	1901-1011		DIODE-ARRAY 5MV	28480	1901-1011
A5CR3	1901-0033	5	DIODE-GEN PRP 180V 200MA DO-7	28480	1901-0033
A5CR4	1901-0033		DIODE-GEN PRP 180V 200MA DO-7	28480	1901-0033
A5CR5	1901-0033		DIODE-GEN PRP 180V 200MA DO-7	28480	1901-0033
A5CR6	1901-0033		DIODE-GEN PRP 180V 200MA DO-7	28480	1901-0033
A5CR7	1901-0159	2	DIODE-PWR RECT 400V 750MA DO-41	04713	SR1358-4
A5CR8	1901-0159		DIODE-PWR RECT 400V 750MA DO-41	04713	SR1358-4
A5CR9	1901-0033		DIODE-GEN PRP 180V 200MA DO-7	28480	1901-0033
A5J1	1200-0508	3	SOCKET-IC 14-CONT DIP-SLDR-TERMS	06776	ICN-143-S3W
A5J2	1200-0508		SOCKET-IC 14-CONT DIP-SLDR-TERMS	06776	ICN-143-S3W
A5J3	1200-0508		SOCKET-IC 14-CONT DIP-SLDR-TERMS	06776	ICN-143-S3W
A5L1	9140-0137	3	COIL-MLD 1MH 5% Q=60 .19DX.44LG SRF=3MHZ	99800	2500-28
A5L2	9140-0137		COIL-MLD 1MH 5% Q=60 .19DX.44LG SRF=3MHZ	99800	2500-28
A5L3	9140-0137		COIL-MLD 1MH 5% Q=60 .19DX.44LG SRF=3MHZ	99800	2500-28
A5MP1-A5MP58	0360-0065	1 58	TERMINAL-STUD PKD-TUR SWGFRM-MTG	28480	0360-0065
A5Q1	1854-0022		TRANSISTOR NPN SI TO-39 PD=700MW	07263	S17843
A5Q2	1854-0023	1	TRANSISTOR NPN SI TO-18 PD=360MW	28480	1854-0023
A5R1	0757-0442		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A5R2*	0757-0439	8	RESISTOR 6.81K 1% .125W F TC=0+-100 *FACTORY SELECTED PART	24546	C4-1/8-T0-6811-F
A5R3	0757-0442		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A5R4*	0757-0439		RESISTOR 6.81K 1% .125W F TC=0+-100 *FACTORY SELECTED PART	24546	C4-1/8-T0-6811-F
A5R5	0757-0442		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A5R6*	0757-0439		RESISTOR 6.81K 1% .125W F TC=0+-100 *FACTORY SELECTED PART	24546	C4-1/8-T0-6811-F
A5R7	0757-0442		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A5R8*	0757-0439		RESISTOR 6.81K 1% .125W F TC=0+-100 *FACTORY SELECTED PART	24546	C4-1/8-T0-6811-F
A5R9	0757-0442		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A5R10*	0757-0439		RESISTOR 6.81K 1% .125W F TC=0+-100 *FACTORY SELECTED PART	24546	C4-1/8-T0-6811-F
A5R11	0757-0442		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A5R12*	0757-0439		RESISTOR 6.81K 1% .125W F TC=0+-100 *FACTORY SELECTED PART	24546	C4-1/8-T0-6811-F
A5R13	0757-0442		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A5R14*	0757-0439		RESISTOR 6.81K 1% .125W F TC=0+-100 *FACTORY SELECTED PART	24546	C4-1/8-T0-6811-F
A5R15	0757-0440	2	RESISTOR 7.5K 1% .125W F TC=0+-100	24546	C4-1/8-T0-7501-F
A5R16	2100-2216	1	RESISTOR-TRMR 5K 10% C TOP-ADJ 1-TRN	73138	62-208-1
A5R17	0757-1094		RESISTOR 1.47K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1471-F
A5R18	2100-2497		RESISTOR-TRMR 2K 10% C TOP-ADJ 1-TRN	73138	62-207-1
A5R19	0698-3152	1	RESISTOR 3.48K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3481-F
A5R20	0757-0200	2	RESISTOR 5.62K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5621-F
A5R21	0757-0442		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A5R22*	0757-0470	7	RESISTOR 162K 1% .125W F TC=0+-100 *FACTORY SELECTED PART	24546	C4-1/8-T0-1623-F
A5R23*	0757-0470		RESISTOR 162K 1% .125W F TC=0+-100 *FACTORY SELECTED PART	24546	C4-1/8-T0-1623-F
A5R24*	0757-0470		RESISTOR 162K 1% .125W F TC=0+-100 *FACTORY SELECTED PART	24546	C4-1/8-T0-1623-F
A5R25*	0757-0470		RESISTOR 162K 1% .125W F TC=0+-100 *FACTORY SELECTED PART	24546	C4-1/8-T0-1623-F
A5R26	0698-3458		RESISTOR 348K 1% .125W F TC=0+-100	91637	CMF-55-1, T-1
A5R27	0757-0465		RESISTOR 100K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1003-F
A5R28*	0757-0470		RESISTOR 162K 1% .125W F TC=0+-100 *FACTORY SELECTED PART	24546	C4-1/8-T0-1623-F

Table 6-2. Replaceable Parts

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
A5R29*	0757-0470		RESISTOR 162K 1% .125W F TC=0+-100 *FACTORY SELECTED PART	24546	C4-1/8-T0-1623-F
A5R30*	0757-0470		RESISTOR 162K 1% .125W F TC=0+-100 *FACTORY SELECTED PART	24546	C4-1/8-T0-1623-F
A5R31	0757-0458		RESISTOR 51.1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5112-F
A5R32	0757-0399	1	RESISTOR 82.5 1% .125W F TC=0+-100	24546	C4-1/8-T0-82R5-F
A5R33*	0757-0419	1	RESISTOR 681 1% .125W F TC=0+-100 *FACTORY SELECTED PART	24546	C4-1/8-T0-681R-F
A5R34	0757-0405	1	RESISTOR 162 1% .125W F TC=0+-100	24546	C4-1/8-T0-162R-F
A5R35*	0757-0274	3	RESISTOR 1.21K 1% .125W F TC=0+-100 *FACTORY SELECTED PART	24546	C4-1/8-T0-1213-F
A5R36	0757-0465		RESISTOR 100K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1003-F
A5R37	0698-3441	1	RESISTOR 215 1% .125W F TC=0+-100	24546	C4-1/8-T0-215R-F
A5R38*	0757-0274		RESISTOR 1.21K 1% .125W F TC=0+-100 *FACTORY SELECTED PART	24546	C4-1/8-T0-1213-F
A5R39	0698-3442	3	RESISTOR 237 1% .125W F TC=0+-100	24546	C4-1/8-T0-237R-F
A5R40*	0757-0428	2	RESISTOR 1.62K 1% .125W F TC=0+-100 *FACTORY SELECTED PART	24546	C4-1/8-T0-1621-F
A5R41	0757-0467	3	RESISTOR 121K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1213-F
A5R42	2100-3161	1	RESISTOR-TRMR 20K 10% C SIDE-ADJ 17-TRN	32997	3006P-1-203
A5R43	0698-3442		RESISTOR 237 1% .125W F TC=0+-100	24546	C4-1/8-T0-237R-F
A5R44*	0757-0278	2	RESISTOR 1.78K 1% .125W F TC=0+-100 *FACTORY SELECTED PART	24546	C4-1/8-T0-1781-F
A5R45	0698-3442		RESISTOR 237 1% .125W F TC=0+-100	24546	C4-1/8-T0-237R-F
A5R46	0757-0458		RESISTOR 51.1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5112-F
A5R47	0698-3432	1	RESISTOR 26.1 1% .125W F TC=0+-100	03888	PME55-1/8-T0-26R1-F
A5R48*	0757-0428		RESISTOR 1.62K 1% .125W F TC=0+-100 *FACTORY SELECTED PART	24546	C4-1/8-T0-1621-F
A5R49	0698-3458		RESISTOR 348K 1% .125W F TC=0+-100	91637	CMF-55-1, T-1
A5R50	0698-3158		RESISTOR 23.7K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2372-F
A5R51	0757-0458		RESISTOR 51.1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5112-F
A5R52	0698-0082	1	RESISTOR 464 1% .125W F TC=0+-100	24546	C4-1/8-T0-4640-F
A5R53	0757-0416		RESISTOR 511 1% .125W F TC=0+-100	24546	C4-1/8-T0-511R-F
A5R54	0757-0485	1	RESISTOR 681K 1% .125W F TC=0+-100	24546	NA4
A5R55	0698-0085	3	RESISTOR 2.61K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2611-F
A5R56	0757-0299	1	RESISTOR 825K 1% .25W F TC=0+-25	24546	NE60
A5R57	0698-3157	1	RESISTOR 19.6K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1962-F
A5R58	0757-0200		RESISTOR 5.62K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5621-F
A5R59†	2100-3056	1	RESISTOR-TRMR 5K 10% C SIDE-ADJ 17-TRN	32997	3006P-1-502
A5R60	0757-0442		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A5R61	0757-0346	2	RESISTOR 10 1% .125W F TC=0+-100	24546	C4-1/8-T0-10R0-F
A5R62	0698-8625	2	RESISTOR 1K .1% .1W F TC=0+-5	07716	MAR-5
A5R63	2100-3052	1	RESISTOR-TRMR 50 20% C SIDE-ADJ 17-TRN	32997	3006P-1-500
A5R64	0698-8625		RESISTOR 1K .1% .1W F TC=0+-5	07716	MAR-5
A5R65	0698-0083	7	RESISTOR 1.96K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1961-F
A5R66*	0757-0447	3	RESISTOR 16.2K 1% .125W F TC=0+-100 *FACTORY SELECTED PART	24546	C4-1/8-T0-1622-F
A5R67	0698-0083		RESISTOR 1.96K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1961-F
A5R68*			NORMALLY OPEN *FACTORY SELECTED PART		
A5R69	0698-0083		RESISTOR 1.96K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1961-F
A5R70*	0757-0288	3	RESISTOR 9.09K 1% .125W F TC=0+-100 *FACTORY SELECTED PART	19701	MF4C1/8-T0-9091-F
A5R71	0698-0083		RESISTOR 1.96K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1961-F
A5R72*	0757-0444	1	RESISTOR 12.1K 1% .125W F TC=0+-100 *FACTORY SELECTED PART	24546	C4-1/8-T0-1212-F
A5R73	0698-0083		RESISTOR 1.96K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1961-F
A5R74*	0757-0443	1	RESISTOR 11K 1% .125W F TC=0+-100 *FACTORY SELECTED PART	24546	C4-1/8-T0-1102-F
A5R75	0698-0083		RESISTOR 1.96K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1961-F
A5R76*	0757-0441	4	RESISTOR 8.25K 1% .125W F TC=0+-100 *FACTORY SELECTED PART	24546	C4-1/8-T0-8251-F
A5R77	0698-3162		RESISTOR 46.4K 1% .125W F TC=0+-100	24546	C4-1/8-T0-4642-F
A5R78	0698-3449	2	RESISTOR 28.7K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2872-F
A5R79	0698-3449		RESISTOR 28.7K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2872-F
A5R80	0698-3156		RESISTOR 14.7K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1472-F
A5R81	0757-0440		RESISTOR 7.5K 1% .125W F TC=0+-100	24546	C4-1/8-T0-7501-F
A5R82	0757-0441		RESISTOR 8.25K 1% .125W F TC=0+-100	24546	C4-1/8-T0-8251-F
A5R83	0757-0346		RESISTOR 10 1% .125W F TC=0+-100	24546	C4-1/8-T0-10R0-F
A5R84*	0757-0123	2	RESISTOR 34.8K 1% .125W F TC=0+-100 *FACTORY SELECTED PART	24546	C4, T-0
A5R85	0698-0085		RESISTOR 2.61K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2611-F
A5R86	0698-0083		RESISTOR 1.96K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1961-F
A5R87	0698-3445	1	RESISTOR 348 1% .125W F TC=0+-100	24546	C4-1/8-T0-348R-F
A5R88	0698-3435	1	RESISTOR 38.3 1% .125W F TC=0+-100	24546	C4-1/8-T0-38R3-F
A5R89*	0757-0424	2	RESISTOR 1.1K 1% .125W F TC=0+-100 *FACTORY SELECTED PART	24546	C4-1/8-T0-1101-F
A5R90	0698-3439	1	RESISTOR 178 1% .125W F TC=0+-100	24546	C4-1/8-T0-178R-F
A5R91*	0757-1094	2	RESISTOR 1.47K 1% .125W F TC=0+-100 *FACTORY SELECTED PART	24546	C4-1/8-T0-1471-F

See introduction to this section for ordering information

† FOR BACKDATING, SEE TABLE 7-1.

Table 6-2. Replaceable Parts

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
A5R92	0757-0458		RESISTOR 51.1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5112-F
A5R93	0757-0290		RESISTOR 6.19K 1% .125W F TC=0+-100	19701	MF4C1/8-T0-6191-F
A5R94	0757-0420	1	RESISTOR 750 1% .125W F TC=0+-100	24546	C4-1/8-T0-751-F
A5R95	0757-0467		RESISTOR 121K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1213-F
A5R96	0698-7332	1	RESISTOR 1M 1% .125W F TC=0+-100	19701	MF5C1/8-T0-1004-F
A5R97	0698-3457		RESISTOR 316K 1% .125W F TC=0+-100	91637	CMF-55-1, T-1
A5R98	0757-0464		RESISTOR 90.9K 1% .125W F TC=0+-100	24546	C4-1/8-T0-9092-F
A5R99	0757-0467		RESISTOR 121K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1213-F
A5R100	0757-0123		RESISTOR 34.8K 1% .125W F TC=0+-100	24546	C4, T-0
A5R101	0698-3161		RESISTOR 38.3K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3832-F
A5R102	0757-0465		RESISTOR 100K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1003-F
A5R103	0698-3153	1	RESISTOR 3.83K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3831-F
A5R104	2100-3103	1	RESISTOR-TRMR 10K 10% C SIDE-ADJ 17-TRN	32997	3006P-1-103
A5R105 †	0757-0421	1	RESISTOR 825 1% .125W F TC=0+-100	24546	C4-1/8-T0-825R-F
A5R106	0757-0424		RESISTOR 1.1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1101-F
A5R107	2100-1986	1	RESISTOR-TRMR 1K 10% C TOP-ADJ 1-TRN	73138	62-206-1
A5R108	0698-0085		RESISTOR 2.61K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2611-F
A5R109	0757-0274		RESISTOR 1.21K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1213-F
A5R110	0757-0465		RESISTOR 100K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1003-F
A5R111	0757-0465		RESISTOR 100K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1003-F
A5R112 †	0757-0441		RESISTOR 8.25K 1% .125W F TC=0+-100	24546	C4-1/8-T0-8251-F
A5R113	0698-3132	1	RESISTOR 261 1% .125W F TC=0+-100	24546	C4-1/8-T0-2610-F
A5R114	0757-0439		RESISTOR 6.81K 1% .125W F TC=0+-100	24546	C4-1/8-T0-6811-F
A5R115	0757-0288		RESISTOR 9.09K 1% .125W F TC=0+-100	19701	MF4C1/8-T0-9091-F
A5R116	0698-3459		RESISTOR 383K 1% .125W F TC=0+-100	91637	CMF-55-1, T-1
A5R117	0757-0464		RESISTOR 90.9K 1% .125W F TC=0+-100	24546	C4-1/8-T0-9092-F
A5R118	0698-3156		RESISTOR 14.7K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1472-F
A5R119	0698-3158		RESISTOR 23.7K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2372-F
A5R120	0757-0442		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A5R121	0698-3457		RESISTOR 316K 1% .125W F TC=0+-100	91637	CMF-55-1, T-1
A5R122	2100-2655	1	RESISTOR-TRMR 100K 10% C TOP-ADJ 1-TRN	73138	62-213-1
A5RT1	0839-0026	2	THERMISTOR NEG TC 10K DISC	73168	JA4112
A5RT2	0839-0026		THERMISTOR NEG TC 10K DISC	73168	JA4112
A5TP1-12	0360-1514		TERMINAL-STUD SGL-PIN PRESS-MTG	28480	0360-1514
A5U1	1826-0092		IC MC 1458 OP AMP	28480	1826-0092
A5U2	1826-0081	2	IC LM 318 OP AMP	27014	LM318H
A5U3	1826-0081		IC LM 318 OP AMP	27014	LM318H
A5U4	1826-0059	3	IC LM 201A OP AMP	27014	LM201AH
A5U5	1826-0013		IC 741 OP AMP	28480	1826-0013
A5U6	1826-0035	2	IC LM 308A OP AMP	27014	LM308AH
A5U7	1826-0035		IC LM 308A OP AMP	27014	LM308AH
A5U8	1826-0092		IC MC 1458 OP AMP	28480	1826-0092
A5U9	1826-0059		IC LM 201A OP AMP	27014	LM201AH
A5U10	1826-0092		IC MC 1458 OP AMP	28480	1826-0092
A5U11	1826-0059		IC LM 201A OP AMP	27014	LM201AH
A5VR1	1902-3345	1	DIODE-ZNR 51.1V 5% DO-7 PD=.4W TC=+.081%	04713	SZ 10939-386

See introduction to this section for ordering information

† FOR BACKDATING, SEE TABLE 7-1.

Table 6-2. Replaceable Parts

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
A6	08654-60037	1	REVERSE POWER ASSEMBLY (OPTION 003 ONNY)	28480	08654-60037
A6FL1	9135-0002	2	FILTER-LP SOLDER-TERMS	28480	9135-0002
A6FL2	9135-0002		FILTER-LP SOLDER-TERMS	28480	9135-0002
A6J1	1250-0829	1	CONNECTOR-RF SMC M SGL-HOLE-FR 50-OHM	98291	50-045-4610
A6J2	1250-0830	1	CONNECTOR-RF SMC M SGL HOLE FR	2K497	701873
A6MP1	08640-20191	1	HOUSING, REVERSE POWER	28480	08640-20191
A6A1 †	08640-60049	1	BOARD ASSEMBLY,REVERSE POWER PROTECTION	28480	08640-60049
A6A1C1	0160-0576	3	CAPACITOR-FXD .1UF +-20% 50WVDC CER	28480	0160-0576
A6A1C2	0160-0576		CAPACITOR-FXD .1UF +-20% 50WVDC CER	28480	0160-0576
A6A1C3	0160-3879	2	CAPACITOR-FXD .01UF +-20% 100WVDC CER	28480	0160-3879
A6A1C4	0180-0197	1	CAPACITOR-FXD 2.2UF+-10% 20VDC TA	56289	150D225X9020A2
A6A1C5	0160-3877	1	CAPACITOR-FXD 100PF +-20% 200WVDC CER	28480	0160-3877
A6A1C6	0160-0576		CAPACITOR-FXD .1UF +-20% 50WVDC CER	28480	0160-0576
A6A1C7	0160-3875	1	CAPACITOR-FXD 22PF +-5% 200WVDC CER	28480	0160-3875
A6A1C8	0160-3873	1	CAPACITOR-FXD 4.7PF +-.5PF 200WVDC CER	28480	0160-3873
A6A1C9	0121-0448	1	CAPACITOR-V TRMR-CER 2.5/5PF 63V PC-MTG	00866	56-TRIKO-04 2.5/5 PF-N033
A6A1C10	0160-0699	1	CAPACITOR-FXD 1PF +-.1PF 100WVDC CER	72982	8101-A112-COK-.098
A6A1C11	0160-3879		CAPACITOR-FXD .01UF +-20% 100WVDC CER	28480	0160-3879
A6A1CR1	1901-0050	2	DIODE-SWITCHING 80V 200MA 2NS DO-7	28480	1901-0050
A6A1CR2	1901-0518	2	DIODE-SCHOTTKY	28480	1901-0518
A6A1CR3	1901-0050		DIODE-SWITCHING 80V 200MA 2NS DO-7	28480	1901-0050
A6A1CR4	1901-0518		DIODE-SCHOTTKY	28480	1901-0518
A6A1K1	0490-1073	1	RELAY-REED 1A 250MA 120VAC 4.5VDC-COIL	28480	0490-1073
A6A1L1	1460-1395	2	WIREFORM CU ALY	28480	1460-1395
A6A1L2	1460-1395		WIREFORM CU ALY	28480	1460-1395
A6A1MP1	0363-0105	2	CONTACT	28480	0363-0105
A6A1MP2	0363-0105		CONTACT	28480	0363-0105
A6A1Q1	1854-0210	3	TRANSISTOR NPN 2N2222 SI TO-18 PD=500MW	04713	2N2222
A6A1Q2	1854-0210		TRANSISTOR NPN 2N2222 SI TO-18 PD=500MW	04713	2N2222
A6A1Q3	1854-0210		TRANSISTOR NPN 2N2222 SI TO-18 PD=500MW	04713	2N2222
A6A1R1	0698-7241	1	RESISTOR 1.62K 1% .05W F TC=0+-100	24546	C-3, T-0
A6A1R2	2100-1986	1	RESISTOR-TRMR 1K 10% C TOP-ADJ 1-TRN	73138	62-206-1
A6A1R3	0683-1055	1	RESISTOR 1M 5% .25W FC TC=-800/+900	01121	CB1055
A6A1R4	0698-7277	2	RESISTOR 51.1K 1% .05W F TC=0+-100	24546	C3-1/8-T0-5112-G
A6A1R5	0698-7212	1	RESISTOR 100 1% .05W F TC=0+-100	24546	C3-1/8-T0-100R-G
A6A1R6	0683-0275	1	RESISTOR 2.7 5% .25W FC TC=-400/+500	01121	CB27G5
A6A1R7	0698-7277		RESISTOR 51.1K 1% .05W F TC=0+-100	24546	C3-1/8-T0-5112-G
A6A1R8	0698-7236	1	RESISTOR 1K 1% .05W F TC=0+-100	24546	C3-1/8-T0-1001-G
A6A1R9	0698-7229	2	RESISTOR 511 1% .05W F TC=0+-100	24546	C3-1/8-T0-511R-G
A6A1R10	0698-7229		RESISTOR 511 1% .05W F TC=0+-100	24546	C3-1/8-T0-511R-G
A6A1R11	0757-0346	1	RESISTOR 10 1% .125W F TC=0+-100	24546	C4-1/8-T0-10R0-F
A6A1U1	1826-0026	1	IC LM 311 COMPARATOR	27014	LM311H
A6A1VR1 †	1902-0554	2	DIODE-ZNR 10V 5% DO-15 PD=1W TC=-.06%	28480	1902-0554
A6A1VR2	1902-0244	1	DIODE-ZNR 30.1V 5% DO-15 PD=1W TC=+.075%	28480	1902-0244
A6A1VR3 †	1902-0554		DIODE-ZNR 10V 5% DO-15 PD=1W TC=-.06%	28480	1902-0554

See introduction to this section for ordering information

† FOR BACKDATING, SEE TABLE 7-1

Table 6-2. Replaceable Parts

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
			CHASSIS PARTS		
C1	0160-0180	1	CAPACITOR-FXD .033UF +-5% 200WVDC POLYE	56289	292P33352
DS1	2140-0244	1	LAMP-GLOW NIH 65/105VDC 1MA T-2-BULB	28480	2140-0245
F1	2110-0004	1	FUSE .25A 250V FAST-BLO 1.25X.25 UL IEC (FOR 100/120V OPERATION)(SEE SECTION 111	75915	312.250
F1	2110-0479	1	FUSE .175A 250V FAST-BLO 1.25X.25 UL (FOR 220/240V OPERATION)(SEE SECTION 111	75915	312.175
J1	1251-0198	1	CONNECTOR-PC EDGE 6-CONT/ROW 2-ROWS	71785	251-06-30-261
J2			CONNECTOR(AUX OUTPUT)NSR, P/O W3		
J3			CONNECTOR(RF OUTPUT) NSR, P/O W5		
J4	1250-0083	1	CONNECTOR-RF BNC FEM SGL-HOLE-FR 50-OHM (PHASE LOCK INPUT)	24931	28JR-130-1
J5			CONNECTOR, NSR, P/O W2		
J6	1250-0118	2	CONNECTOR-RF BNC FEM SGL-HOLE-FR 50-OHM (AM IN/OUT)	24931	28JR128-1
J7	1250-0118		CONNECTOR-RF BNC FEM SGL-HOLE-FR 50-OHM (FM IN/OUT)	24931	28JR128-1
M1	1120-1551	1	METER:0-1 MA, 2-1/4" METER CASE SIZE	28480	1120-1551
MP			FOR MECHANICAL PARTS, SEE PAGE 6-16		
P1	08654-20105	1	BOARD, TERMINAL	28480	08654-20105
R1	2100-2661	1	RESISTOR-VAR CONTROL CC 1K 20% LIN	01121	W
R2	0757-0424	2	RESISTOR 1.1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1101-F
R3	2100-3426	1	RESISTOR-VAR CONTROL CC 1K 20% LIN	01121	70A4G0248102M
R4	0757-0424		RESISTOR 1.1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1101-F
R5	2100-2492	2	RESISTOR-VAR CONTROL CC 5K 20% LIN	01121	W
R6*	0757-0280	1	RESISTOR 1K 1% .125W F TC=0+-100 *FACTORY SELECTED PART	24546	C4-1/8-T0-1001-F
R7	0698-3441	1	RESISTOR 215 1% .125W F TC=0+-100	24546	C4-1/8-T0-215R-F
R8	0698-3160	1	RESISTOR 31.6K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3162-F
R9	2100-2492		RESISTOR-VAR CONTROL CC 5K 20% LIN	01121	W
R10	0757-0398	2	RESISTOR 75 1% .125W F TC=0+-100	24546	C4-1/8-T0-75R0-F
R11	0757-0398		RESISTOR 75 1% .125W F TC=0+-100	24546	C4-1/8-T0-75R0-F
S1	3101-1903	1	SWITCH-SL DPDT-NS MINTR .5A 125VAC/DC (400 HZ/1KHZ)	28480	3101-1903
S2	3100-3304	2	SWITCH, LEVER (AM)	28480	3100-3304
S3	3100-3304		SWITCH, LEVER (FM)	28480	3100-3304
S4	3130-0398	1	WAFER:SECTION 1.718" DIA	76854	TYPE LK
S5	3100-3298	1	SWITCH, ROTARY (METER)	28480	3100-3298
S6	3101-1394	1	SWITCH-PB DPDT-DB ALTNG 10.5A 250VAC (LINE(INCLUDES DS1, MP1 AND MP2)	00591	53-67280-120/A1H
S7	3100-3324	1	SWITCH-RTRY DP4T-NS .812 IN CTR SPCG (FM RANGE)	28480	3100-3324
T1	9100-3568	1	TRANSFORMER, POWER	28480	9100-3568
W1	8120-1378	1	CABLE ASSY 18AWG 3-CNDCT 3GK-JKT .25-OD AC POWER (REFER TO SECTION II)	28480	8120-1378
W2	8120-0668	1	CABLE-COAX .086-OD (BUFFER AMPL OUT) INCLUDES J5.	28480	8120-0668
W3	8120-2175	1	CABLE ASSEMBLY, AUX OUTPUT (INCLUDES J2)	28480	8120-2175
W4	8120-0667	1	CABLE-COAX .086-OD (RF AMPL. OUT)	28480	8120-0667
W5	8120-0670	1	CABLE-COAX .086-OD RF OUTPUT, INCLUDES J3(STANDARD ONLY)	28480	8120-0670
W5	8120-2110	1	CABLE ASSY-COAX 50-OHM 5.418-LG RF OUTPUT, INCLUDES J3(OPT 003 ONLY)	28480	8120-2110
W6	8120-1593	1	CABLE-SHLD 22AWG 5-CNDCT JGK-JKT .26-OD (LINE SWITCH)	28480	8120-1593
W7	8120-0789	3	CABLE-COAX 50 OHM .11-OD 28AWG (+55V)	28480	8120-0789
	8090-0394	6	SLEEVE-TERMN SLDR-HT SHRK .175/.2-ID	06090	C-142-51
	8150-0447	1	WIRE 24AWG BK 300V PVC 7X32 80C	28480	8150-0447
W8	8120-0789		CABLE-COAX 50 OHM .11-OD 28AWG (FM DRIVE)	28480	8120-0789
	8090-0394		SLEEVE-TERMN SLDR-HT SHRK .175/.2-ID	06090	C-142-51
W9	8120-0789		CABLE-COAX 50 OHM .11-OD 28AWG (FM MOD INPUT)	28480	8120-0789
	8090-0394		SLEEVE-TERMN SLDR-HT SHRK .175/.2-ID	06090	C-142-51
W10	8120-2109	1	CABLE ASSY-COAX ATTENUATOR OUTPUT (OPT 003 ONLY)	28480	8120-2109
XA1,XA2			NOT ASSIGNED		
XA3	1251-0159	1	CONNECTOR-PC EDGE 15-CONT/ROW 2-ROWS	71785	251-15-30-261
XA4			NOT ASSIGNED		
XA5	1251-2346	1	CONNECTOR-PC EDGE 18-CONT/ROW 1-ROW	26742	91-6918-1112-00

See introduction to this section for ordering information

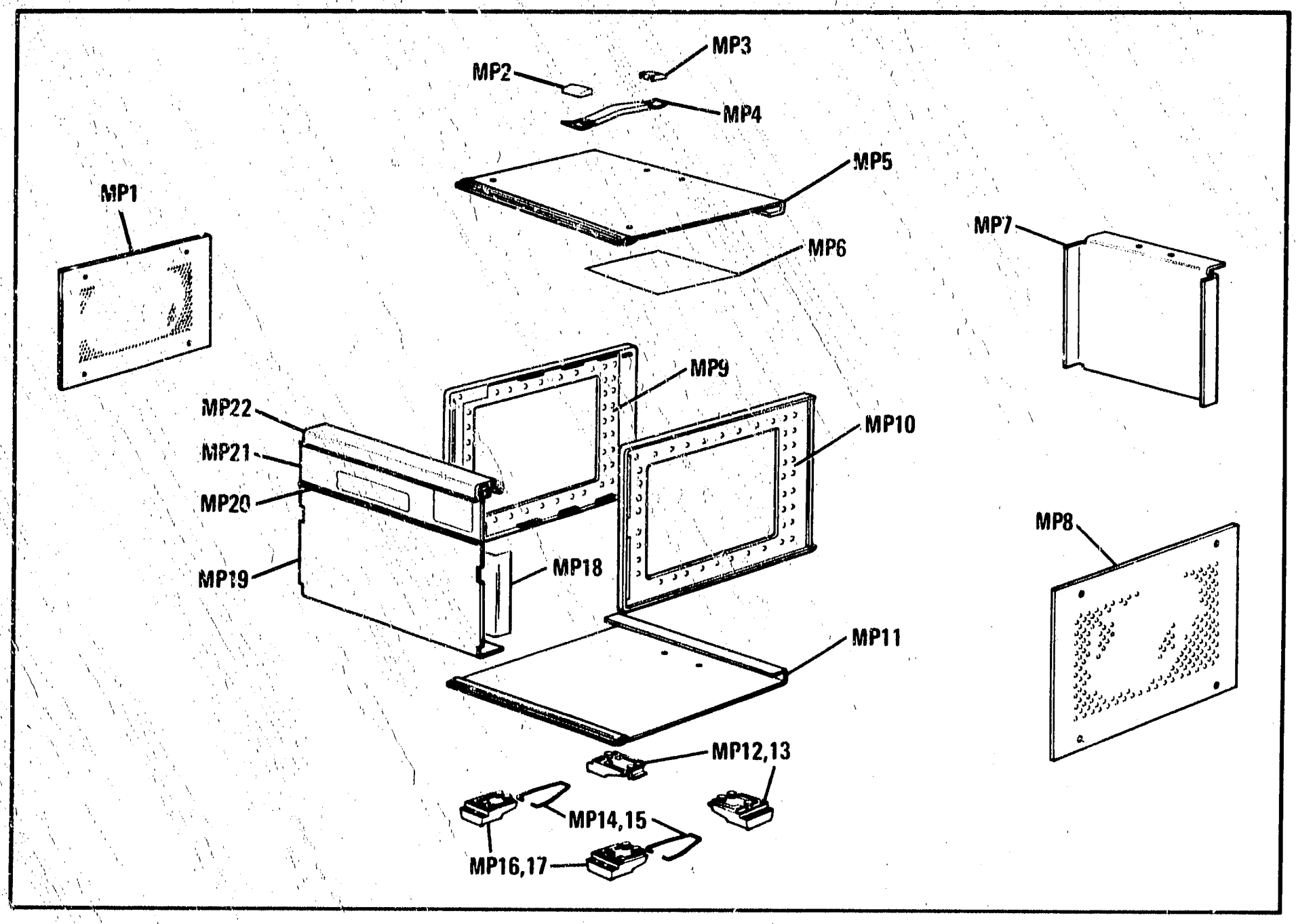


Figure 6-1. Cabinet Parts Exploded View

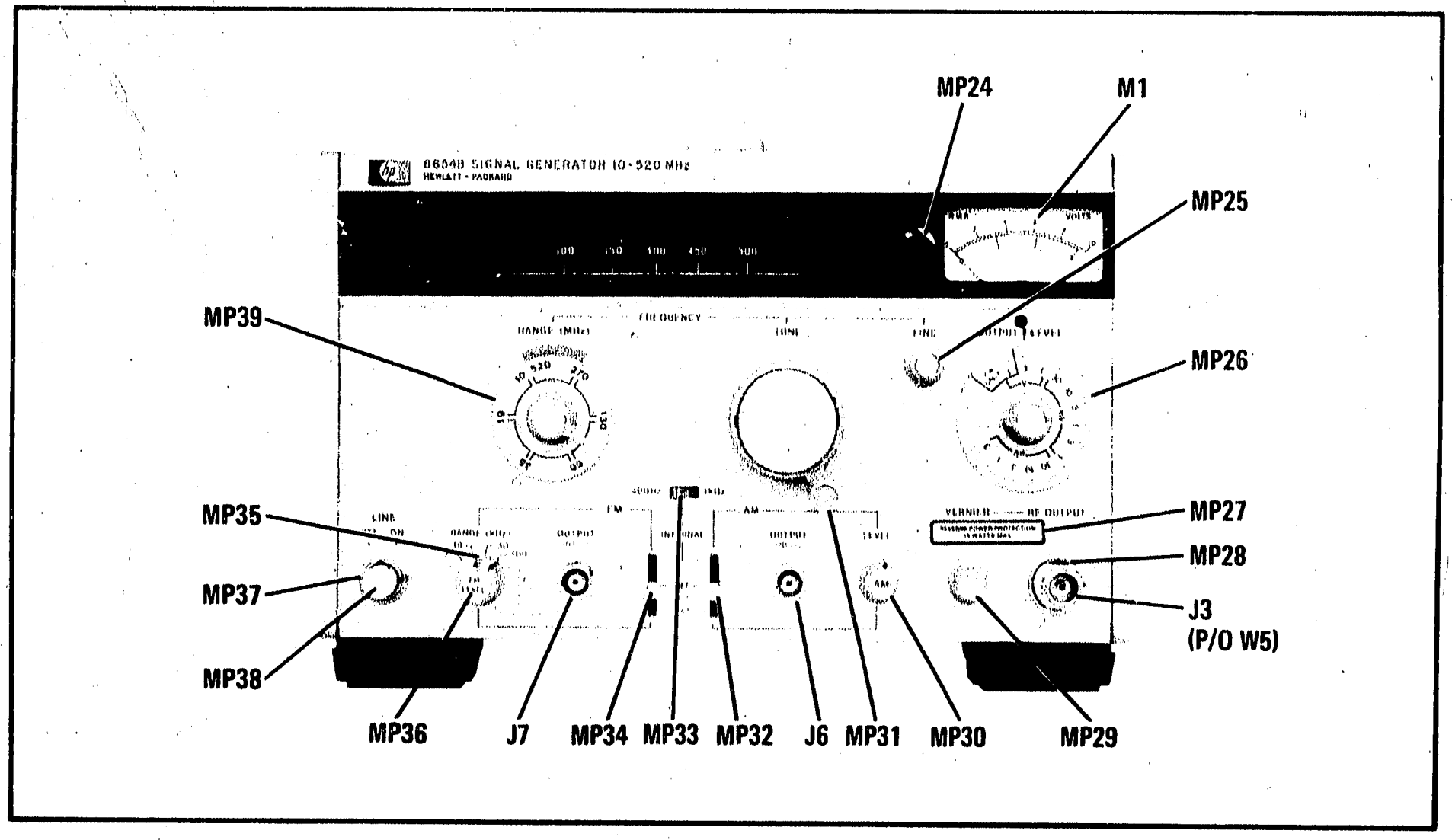


Figure 6-2. Front Panel Mechanical Parts

Table 6-2. Replaceable Parts

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
			MECHANICAL PARTS		
MP1	5000-8876	2	COVER SIDE 6 X 11 SM	28480	5000-8876
MP2	1440-0077	2	HANDLE-CMPNT	12136	346
MP3	1440-0077		HANDLE-CMPNT	12136	346
MP4	1440-0076	1	HANDLE-SPCL 7.75-L	12136	1775-354 COLOR Y31061
MP5	08654-00037	1	COVER, TOP	28480	08654-00037
MP6	08654-20081	1	INSULATOR, FM DRIVER	28480	08654-20081
MP7	08654-00047	1	PANEL, REAR	28480	08654-00047
MP8	5000-8876		COVER SIDE 6 X 11 SM	28480	5000-8876
MP9	5060-0703	2	FRAME ASSEMBLY, 6 X 11 SM	28480	5060-0703
MP10	5060-0703		FRAME ASSEMBLY, 6 X 11 SM	28480	5060-0703
MP11	08654-00024	1	COVER, BOTTOM	28480	08654-00024
MP12	5040-7201	4	FOOT	28480	5040-7201
MP13	5040-7201		FOOT	28480	5040-7201
MP14	1460-1345	2	TILT STAND	28480	1460-1345
MP15	1460-1345		TILT STAND	28480	1460-1345
MP16	5040-7201		FOOT	28480	5040-7201
MP17	5040-7201		FOOT	28480	5040-7201
MP18	08654-00028	1	SUB-PANEL, FRONT	28480	08654-00028
MP19	08654-00027	1	PANEL, FRONT	28480	08654-00027
MP20	7200-1263	1	EXTRUSION;TRIM	28480	7200-1263
MP21	08654-20050	1	WINDOW	28480	08654-20050
MP22	08654-20049	1	TRIM,TOP	28480	08654-20049
MP23	7120-1254	1	NAMEPLATE	28480	7120-1254
MP24	0370-2628	1	KNOB, BAR (METER)	28480	0370-2628
MP25	0370-2383	1	KNOB (FINE FREQUENCY)	28480	0370-2383
MP26	0370-0585	1	KNOB (OUTPUT LEVEL)	28480	0370-0585
MP27	7120-4787	1	LABEL REVERSE POWER (OPT 003 ONLY)	28480	7120-4787
MP28	0590-0505	1	NUT, KNURLED 5/8-24 UNEF-2B THREAD	73743	TD-801
MP29	0370-2623	1	KNOB, BASE (VERNIER)	28480	0370-2623
MP30	0370-2776	1	KNOB (AM LEVEL)	28480	0370-2776
MP31	0370-2245	1	KNOB (FREQUENCY TUNE)	28480	0370-2245
MP32	0370-0929	2	KNOB, LEVER (AM)	28480	0370-0929
MP33	08640-40052	1	LEVER, SLIDE SWITCH (400HZ/1KHZ)	28480	08640-40052
MP34	0370-0929		KNOB, LEVER (FM)	28480	0370-0929
MP35	0370-2986	1	KNOB (FM RANGE)	28480	0370-2986
MP36	0370-2777	1	KNOB (FM LEVEL)	28480	0370-2777
MP37	0590-0923	1	NUT-KNRLD-R 1/2-32-THD .125-THK .635-A/F (SEE SECTION III)	28480	0590-0923
MP38	3101-0559	1	CAP-PB TRL WHITE; ZIG-ZAG 90 DEG TO (SEE SECTION III)	28480	3101-0559
MP39	0370-2778	1	KNOB (FREQUENCY RANGE)	28480	0370-2778
MP40	1250-0522	1	CAP-COAX TO PIT F-N NON-SHTG 1.75 IN	24931	25PC100-1
MP41	7120-2359	1	SERIAL PLATE .625-IN-WD 1.5-IN-LG AL	28480	7120-2359
MP42	08654-00033	1	BRACKET, ATTENUATOR SUPPORT	28480	08654-00033
MP43	08654-00031	1	BRACKET, METER SWITCH	28480	08654-00031
MP44	08654-00049	1	BRACKET, RF CONNECTOR SUPPORT	28480	08654-00049
MP45	08654-00048	1	BRACKET, FM DRIVE BOARD MOUNTING	28480	08654-00048
MP46	08654-20080	2	STANDOFF,TOP COVER	28480	08654-20080
MP47	7120-4294	1	LABEL, WARNING	28480	7120-4294
MP48	08654-00052	1	BRACKET, METER SUPPORT	28480	08654-00052
MP49	1500-0431	1	COUPLER-FLEX 1.05-LG BRS	28480	1500-0431
MP50	08654-20052	1	SHAFT, METER KNOB	28480	08654-20052
MP51	08654-20069	1	DAMP BAR TOP	28480	08654-20069
MP52	5001-0135	1	WRENCH COMBINATION	28480	5001-0135
MP53	7120-4628	1	LABEL INFORMATION "CAUTION"	28480	7120-4628
MP54	08654-20080		STANDOFF, TOP COVER	28480	08654-20080
MP55	08654-00032	1	HINGE, FM DRIVER BOARD	28480	08654-00032
MP56	08654-00008	1	BRACKET, CONNECTOR	28480	08654-00008
MP57	08654-20071	1	DAMP BAR BOTTOM	28480	08654-20071
MP58	5040-0218	1	COUPLER	28480	5040-0218
MP59	8160-0245	1	GASKET (OPT 003 ONLY)	28480	8160-0245
MP60	1401-0101	1	COVER, POWER MODULE	28480	1401-0101
MP61	08654-00022	1	PLATE, LOCKOUT	28480	08654-00022
MP62 †	08654-20088	1	BRACKET	28480	08654-20088
MP63	08654-00045	1	BRACKET, ATTENUATOR	28480	08654-00045
MP64 †	3050-0010	4	WASHER-FL MTLC NO.-6 .147-IN-ID	78210	65
MP65 †	1460-0036	1	SPRING-CPRSN .197-OD .281-LG MUW (FOR FM LEVEL POT SHAFT)	28480	1460-0036

See introduction to this section for ordering information

† FOR BACKDATING, SEE TABLE 7-1.

Table 6-3. Code List of Manufacturers

Mfr Code	Manufacturer Name	Address	Zip Code
GB027	NEOHM	ENGLAND	
00000	U.S.A. COMMON	ANY SUPPLIER OF THE U.S.	
00184	AR TECH PACKAGING CORP	LOWELL MA	01854
00865	STETTNER-TRUSH INC	CAZENOVIA NY	13035
01121	ALLEN-BRADLEY CO	MILWAUKEE WI	53212
01295	TEXAS INSTR INC SEMICOND CMPNT DIV	DALLAS TX	75231
02114	FERROXCUBE CORP	SAUGERTIES NY	12477
02735	RCA CORP SOLID STATE DIV	SOMMERVILLE NJ	08876
03877	TRANSITRON ELECTRONIC CORP	WAKEFIELD MA	01880
03888	KDI PYROFILM CORP	WHIPPANY NJ	07981
04713	MOTOROLA SEMICONDUCTOR PRODUCTS	PHOENIX AZ	85008
06776	ROBINSON NUGENT INC	NEW ALBANY IN	47150
07263	FAIRCHILD SEMICONDUCTOR DIV	MOUNTAIN VIEW CA	94040
07700	TECHNICAL WIRE PRODUCTS INC	CRANFORD NJ	07016
07716	TRW INC BURLINGTON DIV	BURLINGTON IA	52601
11502	TRW INC BOONE DIV	BOONE NC	28607
12881	METEX CORP	EDISON NJ	08817
15818	TELEDYNE SEMICONDUCTOR	MOUNTAIN VIEW CA	94040
19701	MEPCO/ELECTRA CORP	MINERAL WELLS TX	76067
2K497	CABLEWAVE SYSTEMS INC	NORTH HAVEN CT	06473
24226	GOWANDA ELECTRONICS CORP	GOWANDA NY	14070
24546	CORNING GLASS WORKS (BRADFORD)	BRADFORD PA	16701
27014	NATIONAL SEMICONDUCTOR CORP	SANTA CLARA CA	95051
28480	HEWLETT-PACKARD CO CORPORATE HQ	PALO ALTO CA	94304
30983	MEPCO/ELECTRA CORP	SAN DIEGO CA	92121
32997	BOURNS INC TRIMPOT PROD DIV	RIVERSIDE CA	92507
56289	SPRAGUE ELECTRIC CO	NORTH ADAMS MA	01247
59730	THOMAS & BETTS CO THE	ELIZABETH NJ	07207
71616	COMMERCIAL PLASTICS CO	MUNDELEIN IL	60060
72136	ELECTRO MOTIVE CORP SUB IEC	WILLIMANTIC CT	06226
72962	ELASTIC STOP NUT DIV OF AMERACE	UNION NJ	07083
72982	ERIE TECHNOLOGICAL PRODUCTS INC	ERIE PA	16512
73138	BECKMAN INSTRUMENTS INC HELIPOT DIV	FULLERTON CA	92634
73168	FENWAL INC	ASHLAND MA	01721
73734	FEDERAL SCREW PRODUCTS CO	CHICAGO IL	60618
74163	PHELPS DODGE CORP	NEW YORK NY	10022
76210	MARWEDEL C W	SAN FRANCISCO CA	94103
76385	MINOR RUBBER CO INC	BLOOMFIELD NJ	07003
76854	OAK IND INC SW DIV	CRYSTAL LAKE IL	60014
78189	ILLINOIS TOOL WORKS INC SHAKEPROOF	ELGIN IL	60126
79136	WALDES-KOHINOOR INC	LONG ISLAND CITY NY	11101
79727	C-W INDUSTRIES	WARMINSTER PA	18974
91637	DALE ELECTRONICS INC	COLUMBUS NE	68601
94033	LA POINTE INDUSTRIES INC	ROCKVILLE CT	06066
95275	VITRAMON INC	BRIDGEPORT CT	06601
97464	INDUSTRIAL RETAINING RING CO	IRVINGTON NJ	07111
98291	SEALECTRO CORP	MAMARONECK NY	10544
99800	AMER PRCN IND INC DELEVAN DIV	AURORA NY	14052

BACK DATING MANUAL CHANGES

SECTION VII
MANUAL CHANGES

7-1. INTRODUCTION

7-2. This section contains manual change instructions for backdating this manual for HP Model 8654B Signal Generators that have serial number prefixes that are different than the first prefix listed on the title page. This section also contains instrument modification suggestions and procedures that are recommended to improve the performance and reliability of your generator.

7-3. MANUAL CHANGES

7-4. To adapt this manual to your instrument, refer to Table 7-1 and make all of the manual changes listed opposite your instrument's serial number or prefix. The manual changes are listed in serial number sequence and should be made in the sequence listed. For example, Change A should be made after Change B; Change B should be made after Change C; etc.

7-5. If your instrument's serial number or prefix is not listed on the title page of this manual or in Table 7-1, it may be documented in a MANUAL CHANGES supplement. For additional important information about serial number coverage, refer to INSTRUMENTS COVERED BY MANUAL in Section I.

Table 7-1. Manual Changes By Serial Number

Serial Prefix or Number	Make Manual Changes
1512A, 1521A	I,H,G,F,E,D,C,B,A
1529A	I,H,G,F,E,D,C,B
1531A	I,H,G,F,E,D,C
1532A	I,H,G,F,E,D
1550A	I,H,G,F,E
1612A	I,H,G,F
1633A	I,H,G
1638A00696 to 00935	I,H
1638A00936 to 01095, 1647A	I

7-6. MANUAL CHANGE INSTRUCTIONS

CHANGE A

Page 5-3, Table 5-1:
Add the following:

Reference Designator	Basis of Selection	Normal Value Range	Service Sheet
A1A1R25	Selected for harmonic distortion and Auxiliary RF output level within specifications. Perform Harmonic Distortion Test (paragraph 4-14). If harmonics exceed the specified level, increase the value of A1A1R25. Check Auxiliary RF Output to ensure that the RF level exceeds specified level after A1A1R25 has been changed.	75-121Ω	3

CHANGE A (Cont'd)

Page 5-3, Table 5-1: (cont'd)

Change A1A1R28 to A1A1R29.
Change A1A1R31 to A1A1R39.

Page 6-5, Table 6-2:
Change A1MP81 to 08654-20060.

Pages 6-6 and 6-7, Table 6-2:
Replace entire parts list for A1A1 RF Amplifier/ALC Board Assembly with the attached replaceable parts table (pages 7-3 and 7-4).

Service Sheet 3 (component locations):
Replace Figure 8-8 with the following figure:

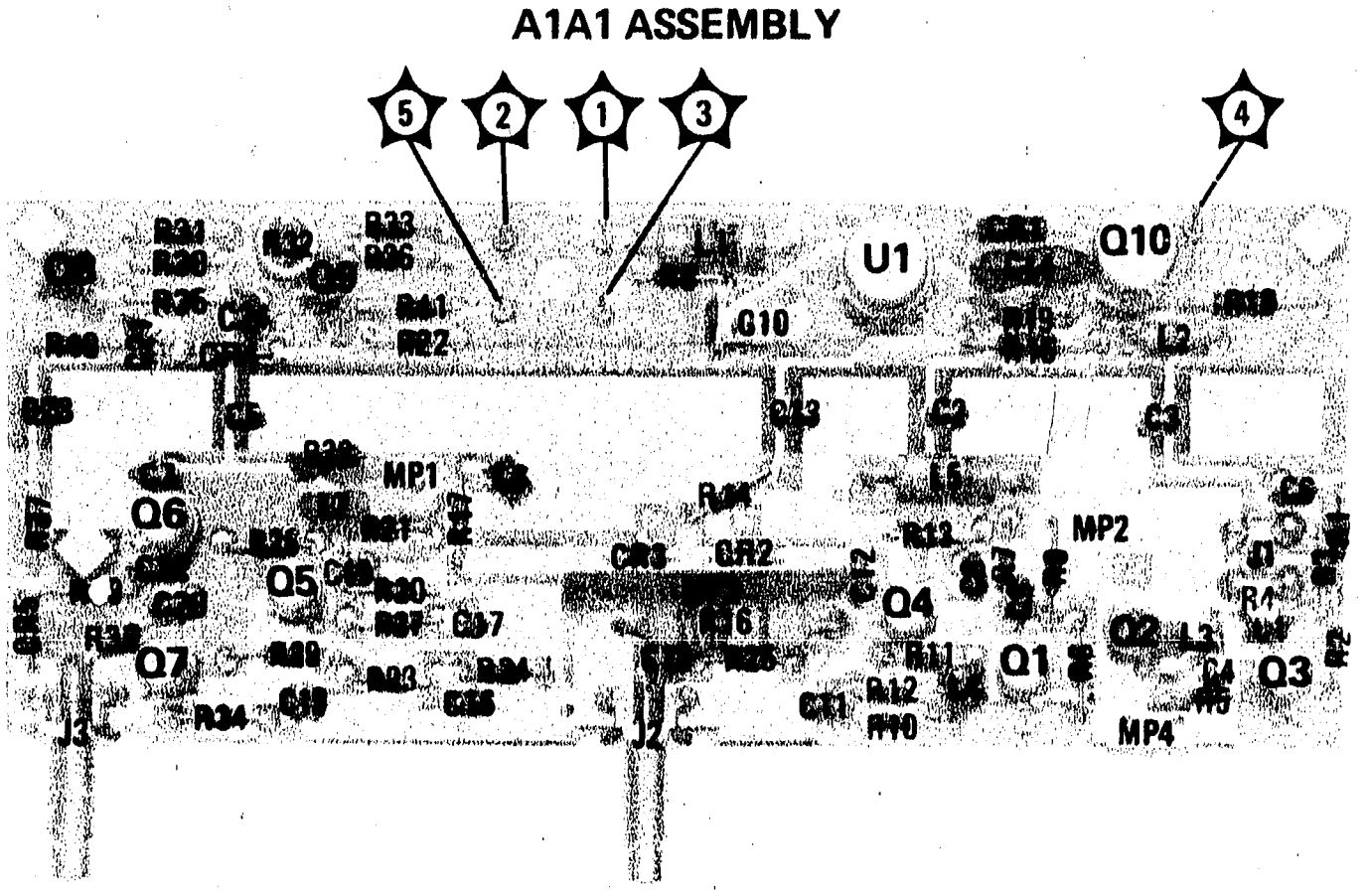


Figure 7-1. A1A1 RF Amplifier/ALC Assembly Component Locations Backdating (Change A)

Service Sheet 3 (schematic):
Replace entire schematic with Figure 7-2 (page 7-5).

CHANGE B

Page 6-10, Table 6-2:
Change A3R60 to 0757-0438 RESISTOR 5.11KΩ 1% 0.125W F TC=0±100.

Service Sheet 4 (schematic):
Change A3R60 to 5.11kΩ.

Table 7-2. A1A1 Replaceable Parts Backdating (Change A)

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
A1A1	08654-60102	1	BOARD ASSEMBLY, RF AMPLIFIER/ALC	28480	08654-60102
A1A1	08654-60022		RESTORED 08654-60002 OR 08654-60102, REQUIRES EXCHANGE	28480	08654-60022
A1A1C1	0160-3879	13	CAPACITOR-FXD .01UF +-20% 100WVDC CER	28480	0160-3879
A1A1C2	0160-3879		CAPACITOR-FXD .01UF +-20% 100WVDC CER	28480	0160-3879
A1A1C3	0160-3879		CAPACITOR-FXD .01UF +-20% 100WVDC CER	28480	0160-3879
A1A1C4*	0160-3565	1	CAPACITOR-FXD 6.8PF +-.5PF 100WVDC CER *FACTORY SELECTED PART	28480	0160-3565
A1A1C5	0160-3879		CAPACITOR-FXD .01UF +-20% 100WVDC CER	28480	0160-3879
A1A1C6	0160-3879		CAPACITOR-FXD .01UF +-20% 100WVDC CER	28480	0160-3879
A1A1C7	0160-3879		CAPACITOR-FXD .01UF +-20% 100WVDC CER	28480	0160-3879
A1A1C8	0160-3878	3	CAPACITOR-FXD 1000PF +-20% 100WVDC CER	28480	0160-3878
A1A1C9	0160-3879		CAPACITOR-FXD .01UF +-20% 100WVDC CER	28480	0160-3879
A1A1C10	0160-2257	1	CAPACITOR-FXD 1[illegible]F +-5% 500WVDC CER	28480	0160-2257
A1A1C11	0160-3879		CAPACITOR-FXD .01UF +-20% 100WVDC CER	28480	0160-3879
A1A1C12	0160-3879		CAPACITOR-FXD .01UF +-20% 100WVDC CER	28480	0160-3879
A1A1C13	0160-3879		CAPACITOR-FXD .01UF +-20% 100WVDC CER	28480	0160-3879
A1A1C14	0160-2204	1	CAPACITOR-FXD 100PF +-5% 300WVDC MICA	28480	0160-2204
A1A1C15	0160-3877	1	CAPACITOR-FXD 100PF +-20% 200WVDC CER	28480	0160-3877
A1A1C16	0160-3879		CAPACITOR-FXD .01UF +-20% 100WVDC CER	28480	0160-3879
A1A1C17	0160-3873	1	CAPACITOR-FXD 4.7PF +-.5PF 200WVDC CER	28480	0160-3873
A1A1C18	0160-3879		CAPACITOR-FXD .01UF +-20% 100WVDC CER	28480	0160-3879
A1A1C19	0160-3879		CAPACITOR-FXD .01UF +-20% 100WVDC CER	28480	0160-3879
A1A1C20	0160-3878		CAPACITOR-FXD 1000PF +-20% 100WVDC CER	28480	0160-3878
A1A1C21	0160-3875	2	CAPACITOR-FXD 22PF +-5% 200WVDC CER	28480	0160-3875
A1A1C22	0160-3876	1	CAPACITOR-FXD 47PF +-20% 200WVDC CER	28480	0160-3876
A1A1C23	0160-3875		CAPACITOR-FXD 22PF +-5% 200WVDC CER	28480	0160-3875
A1A1C24	0160-3878		CAPACITOR-FXD 1000PF +-20% 100WVDC CER	28480	0160-3878
A1A1CR1	1901-0033	1	DIODE-GEN PRP 180V 200MA DO-7	28480	1901-0033
A1A1CR2	1901-0747	2	DIODE-PIN	28480	1901-0747
A1A1CR3	1901-0747		DIODE-PIN	28480	1901-0747
A1A1CR4	1901-0535	2	DIODE-SCHOTTKY	28480	1901-0535
A1A1CR5	1901-0535		DIODE-SCHOTTKY	28480	1901-0535
A1A1J1	1250-1220	3	CONNECTOR-RF SMC M PC	98291	50-051-0109
A1A1J2	1250-1220		CONNECTOR-RF SMC M PC	98291	50-051-0109
A1A1J3	1250-1220		CONNECTOR-RF SMC M PC	98291	50-051-0109
A1A1L1	9140-0114	1	COIL-MLD 10UH 10% Q=55 .155DX.375LG	99800	1537-36
A1A1L2	9100-2252	1	COIL-FXD MOLDED RF CHOKE .27UH 10%	24226	10/270
A1A1L3	08654-80001	1	INDUCTOR, RF 15 NH	28480	08654-80001
A1A1L4	08654-80003	1	INDUCTOR, RF 45 NH	28480	08654-80003
A1A1L5	9100-1623	1	COIL-MLD 27UH 5% Q=60 .155DX.375LG	24226	15/272
A1A1L6	08654-80002	1	INDUCTOR, RF 35 NH	28480	08654-80002
A1A1L7	9100-2247	1	COIL-FXD MOLDED RF CHOKE .1UH 10%	24226	10/100
A1A1MP1	0340-0008	1	TERMINAL-STUD DBL-TUR PRESS-MTG	98291	ST-1000-L2
A1A1MP2	08654-00019	1	SHIELD, BUFFER AMPLIFIER	28480	08654-00019
A1A1MP3	08654-00020	1	SHIELD, MODULATOR	28480	08654-00020
A1A1MP4	08654-00021	1	STRAP GROUND	28480	08654-00021
A1A1Q1	1854-0696	5	TRANSISTOR NPN SI TO-72 PD=200MW	28480	1854-0696
	1205-0037	6	HEAT SINK TO-36-PKG	28480	1205-0037
A1A1Q2	1855-0020	1	TRANSISTOR J-FET N-CHAN D-MODE TO-18 SI	28480	1855-0020
A1A1Q3	1854-0696		TRANSISTOR NPN SI TO-72 PD=200MW	28480	1854-0696
	1205-0037		HEAT SINK TO-36-PKG	28480	1205-0037
A1A1Q4	5086-4218	1	HP-21 TO TO-72 PACKAGE	28480	5086-4218
	1205-0037		HEAT SINK TO-36-PKG	28480	1205-0037
A1A1Q5	1854-0696		TRANSISTOR NPN SI TO-72 PD=200MW	28480	1854-0696
	1205-0037		HEAT SINK TO-36-PKG	28480	1205-0037
A1A1Q6	1854-0696		TRANSISTOR NPN SI TO-72 PD=200MW	28480	1854-0696
	1205-0037		HEAT SINK TO-36-PKG	28480	1205-0037
A1A1Q7	1854-0696		TRANSISTOR NPN SI TO-72 PD=200MW	28480	1854-0696
	1205-0037		HEAT SINK TO-36-PKG	28480	1205-0037
A1A1Q8	1853-0020	1	TRANSISTOR PNP SI PD=300MW FT=150MHZ	28480	1853-0020
A1A1Q9	1854-0071	1	TRANSISTOR NPN SI PD=300MW FT=200MHZ	28480	1854-0071
A1A1Q10	1853-0001	1	TRANSISTOR PNP SI TO-39 PD=600MW	28480	1853-0001
A1A1R1	0698-7216	1	RESISTOR 147 1% .05W F TC=0+-100	24546	C3-1/8-T0-147R-G
A1A1R2	0698-7208	1	RESISTOR 68.1 1% .05W F TC=0+-100	24546	C3-1/8-T00-68R1-G
A1A1R3	0698-7232	1	RESISTOR 681 1% .05W F TC=0+-100	24546	C3-1/8-T0-681R-G
A1A1R4	0698-7227	1	RESISTOR 422 1% .05W F TC=0+-100	24546	C3-1/8-T0-422R-G
A1A1R5	0698-7205	3	RESISTOR 51.1 1% .05W F TC=0+-100	24546	C3-1/8-T00-51R1-G
A1A1R6	0698-7196	1	RESISTOR 21.5 2% .05W F TC=0+-100	24546	C3-1/8-T00-21R5-G
A1A1R7	0698-7253	3	RESISTOR 5.11K 1% .05W F TC=0+-100	24546	C3-1/8-T0-5111-G
A1A1R8	0698-7277	2	RESISTOR 51.1K 1% .05W F TC=0+-100	24546	C3-1/8-T0-5112-G
A1A1R9	0698-7253		RESISTOR 5.11K 1% .05W F TC=0+-100	24546	C3-1/8-T0-5111-G
A1A1R10	0698-7214	1	RESISTOR 121 1% .05W F TC=0+-100	24546	C3-1/8-T0-121R-G

Table 7-2. A1A1 Replaceable Parts Backdating (Change A)

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
A1A1R11	0698-7188	2	RESISTOR 10 1% .05W F TC=0+-100	24546	C3-1/8-T00-10R-G
A1A1R12	0698-7207	1	RESISTOR 61.9 1% .05W F TC=0+-100	24546	C3-1/8-T00-61R9-G
A1A1R13	0698-7205		RESISTOR 51.1 1% .05W F TC=0+-100	24546	C3-1/8-T00-51R1-G
A1A1R14	0698-7224	1	RESISTOR 316 1% .05W F TC=0+-100	24546	C3-1/8-T0-316R-G
A1A1R15	0757-0401	1	RESISTOR 100 1% .125W F TC=0+-100	24546	C4-1/8-T0-101-F
A1A1R16	0757-0814	1	RESISTOR 511 1% .5W F TC=0+-100	19701	MF7C1/2-T0-511R-F
A1A1R17	0698-7205		RESISTOR 51.1 1% .05W F TC=0+-100	24546	C3-1/8-T00-51R1-G
A1A1R18	0757-0442	1	RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A1A1R19	0698-7284	2	RESISTOR 100K 1% .05W F TC=0+-100	24546	C3-1/8-T0-1003-G
A1A1R20	0698-7239	1	RESISTOR 1.33K 1% .05W F TC=0+-100	24546	C3-1/8-T0-1331-G
A1A1R21	0698-7247	1	RESISTOR 2.87K 1% .05W F TC=0+-100	24546	C3-1/8-T0-2871-G
A1A1R22	0698-7277		RESISTOR 51.1K 1% .05W F TC=0+-100	24546	C3-1/8-T0-5112-G
A1A1R23	0698-7198	2	RESISTOR 26.1 1% .05W F TC=0+-100	24546	C3-1/8-T00-26R1-G
A1A1R24	0698-7217	1	RESISTOR 162 1% .05W F TC=0+-100	24546	C3-1/8-T0-162R-G
A1A1R25*	0698-7209	1	RESISTOR 75 1% .05W F TC=0+-100 *FACTORY SELECTED PART	24546	C3-1/8-T00-75R0-G
A1A1R26	0698-7198		RESISTOR 26.1 1% .05W F TC=0+-100	24546	C3-1/8-T00-26R1-G
A1A1R27	0698-7188		RESISTOR 10 1% .05W F TC=0+-100	24546	C3-1/8-T00-10R-G
A1A1R28	0698-3444	1	RESISTOR 316 1% .125W F TC=0+-100	24546	C4-1/8-T0-316R-F
A1A1R29*	0698-7216	1	RESISTOR 147 1% .05W F TC=0+-100 *FACTORY SELECTED PART	24546	C3-1/8-T0-147R-G
A1A1R30	0698-7248	1	RESISTOR 3.16K 1% .05W F TC=0+-100	24546	C3-1/8-T0-3161-G
A1A1R31	0698-7269	1	RESISTOR 23.7K 1% .05W F TC=0+-100	24546	C3-1/8-T0-2372-G
A1A1R32	2100-2497	1	RESISTOR-TRMR 2K 10% C TOP-ADJ 1-TRN	73138	62-207-1
A1A1R33	0698-7245	1	RESISTOR 2.37K 1% .05W F TC=0+-100	24546	C3-1/8-T0-2371-G
A1A1R34	0698-7195	1	RESISTOR 19.6 1% .05W F TC=0+-100	24546	C3-1/8-T00-19R6-G
A1A1R35	0698-7279	1	RESISTOR 61.9K 1% .05W F TC=0+-100	24546	C3-1/8-T0-6192-G
A1A1R36	0698-7286	1	RESISTOR 121K 1% .05W F TC=0+-100	24546	C3-1/8-T0-1213-G
A1A1R37	0698-7253		RESISTOR 5.11K 1% .05W F TC=0+-100	24546	C3-1/8-T0-5111-G
A1A1R38	0698-7201	1	RESISTOR 34.8 1% .05W F TC=0+-100	24546	C3-1/8-T00-34R8-G
A1A1R39*	0698-7212	1	RESISTOR 100 1% .05W F TC=0+-100 *FACTORY SELECTED PART	24546	C3-1/8-T0-100R-G
A1A1R40	0698-7256	1	RESISTOR 6.81K 1% .05W F TC=0+-100	24546	C3-1/8-T0-6811-G
A1A1R41	0698-7284		RESISTOR 100K 1% .05W F TC=0+-100	24546	C3-1/8-T0-1003-G
A1A1TP1	0360-0124	5	TERMINAL-STUD SGL-PIN PRESS-MTG	28480	0360-0124
A1A1TP2	0360-0124		TERMINAL-STUD SGL-PIN PRESS-MTG	28480	0360-0124
A1A1TP3	0360-0124		TERMINAL-STUD SGL-PIN PRESS-MTG	28480	0360-0124
A1A1TP4	0360-0124		TERMINAL-STUD SGL-PIN PRESS-MTG	28480	0360-0124
A1A1TP5	0360-0124		TERMINAL-STUD SGL-PIN PRESS-MTG	28480	0360-0124
A1A1U1	1820-0223	1	IC LM 301A OP AMP	27014	LM301AH

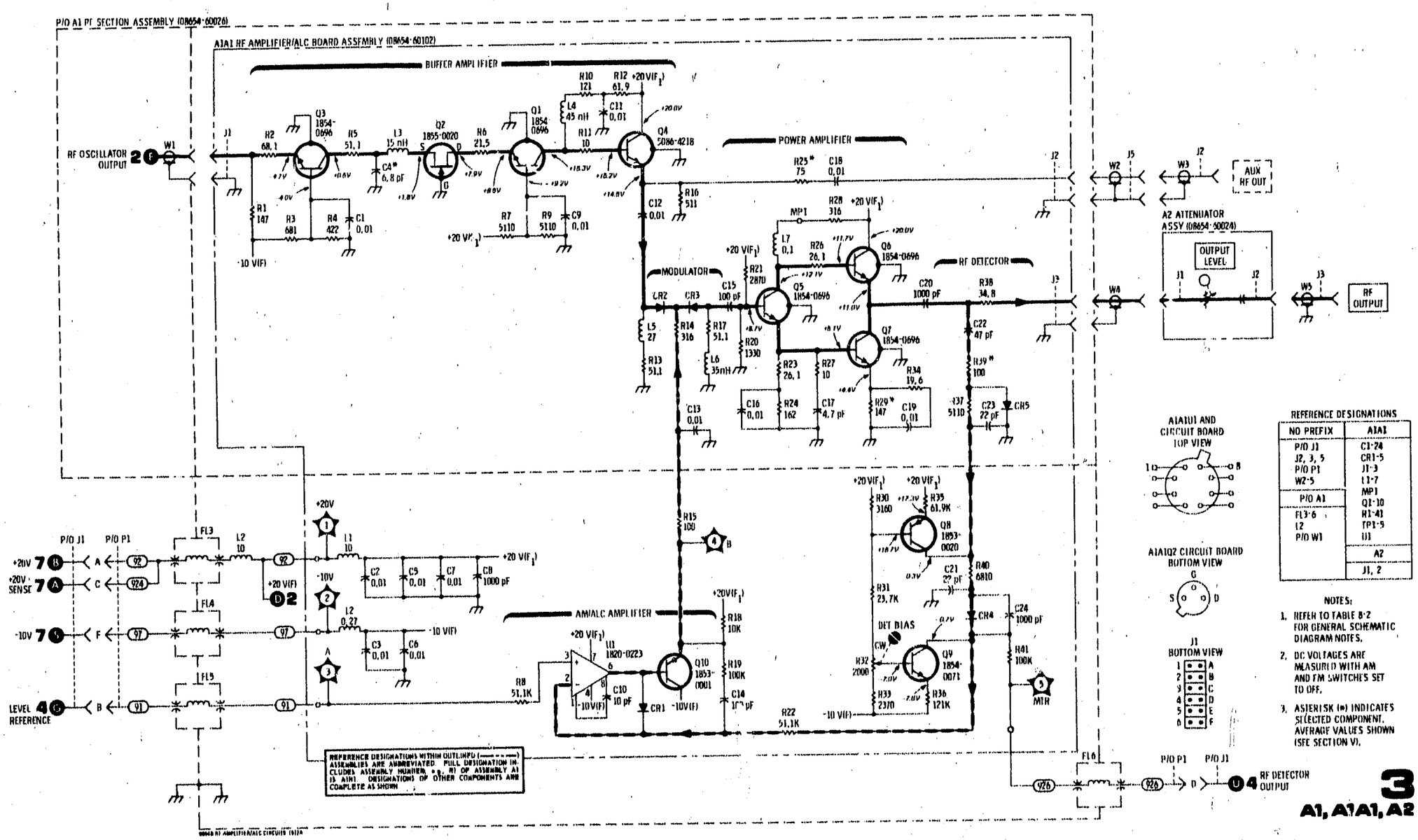


Figure 7-2. RF Amplifier/ALC Assembly Schematic Diagram Backdating (Change A).

CHANGE C

NOTE

See paragraph 7-19 for recommended instrument modification.

Page 6-14, Table 6-2:
Change A6A1 to 08654-60109.

Change A6A1VR1 and VR3 to 1902-3048 DIODE-ZNR 3.48 5% DO-7 PD=0.4W TC= −0.058%.

Page 6-16, Table 6-2:
Change MP62 to 08654-00030 with the same description.

Delete MP64.

Service Sheet 3A (schematic):
Change the part number for A6A1 to 08654-60109.

Change the voltage for A6A1VR1 and VR3 to 3.48V.

CHANGE D

Page 6-12, Table 6-2:
Change A5R59 to 2100-2216 RESISTOR—VAR TRMR 5 KOHM 10% C TOP—ADJ

Service Sheet 6 (component locations):
Replace Figure 8-22 with Figure 7-3 (page 7-7).

CHANGE E

NOTE

See paragraph 7-17 for recommended instrument modification.

Page 6-9, Table 6-2:
Change A3C23 to 0160-2257 CAPACITOR—FXD 10 PF ±5% 500 WVDC CER.
Change A3R7 to 0683-0475 RESISTOR 4.7 OHM 5% 0.25W FC TC=-400/+500.

Service Sheet 4 (schematic):
Change the value of A3C23 to 10 pF.

Service Sheet 7 (schematic):
Change A3R7 to 4.7Ω.

CHANGE F

NOTE

See paragraph 7-15 for recommended instrument modification.

Page 6-6, Table 6-2:
Change A1A1C9 to 0140-0191 CAPACITOR—FXD 56 PF ±5% 300WVDC MICA.

Page 6-16. Table 6-2:
Delete MP65.

Service Sheet 3 (schematic):
Change A1A1C9 to 56 pF.

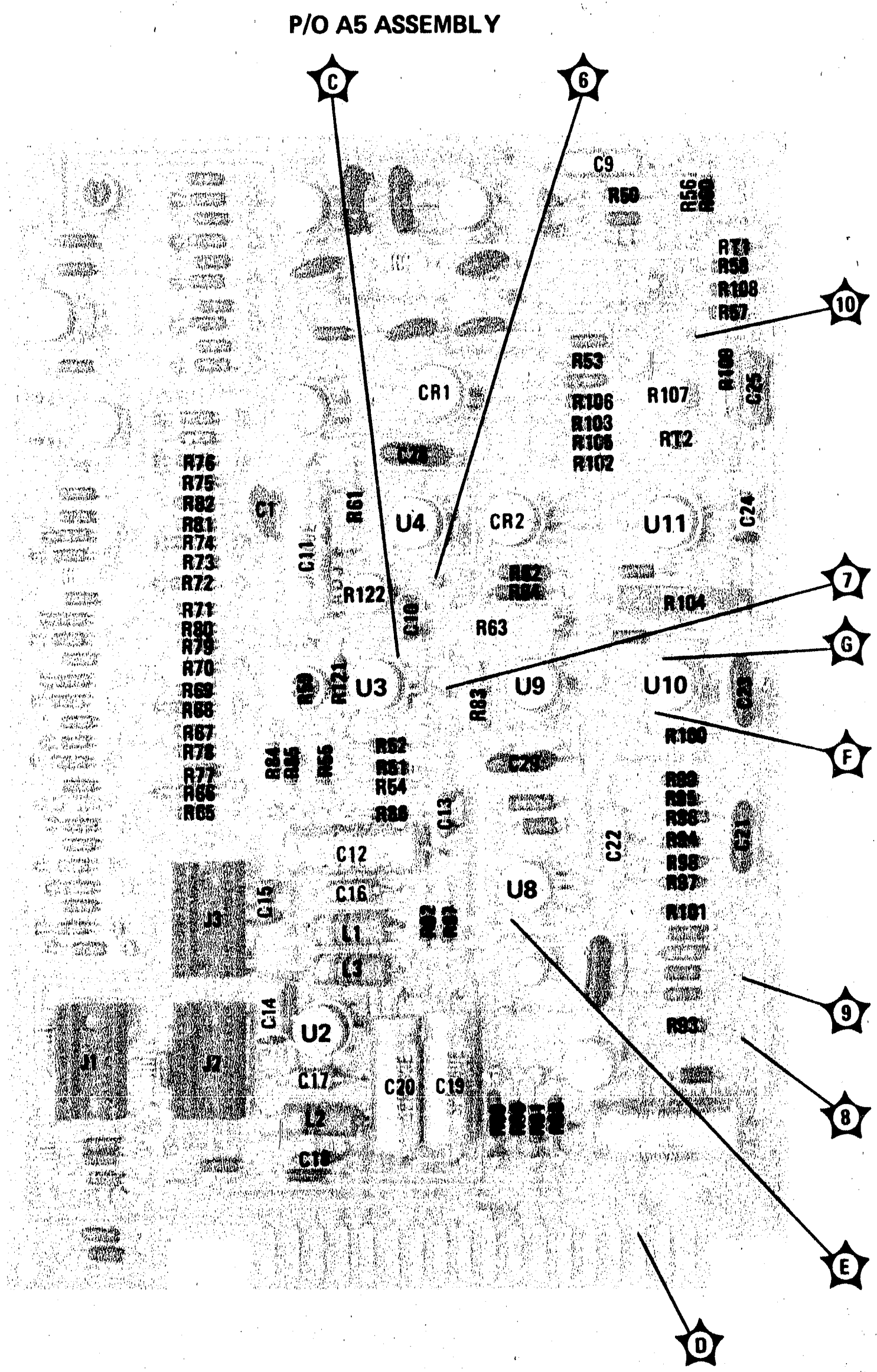


Figure 7-3. P/O A5 FM Driver Board Assembly Component Locations Backdating (Change D)

CHANGE G

NOTE

See paragraphs 7-11 and 7-13 for recommended instrument modifications.

Page 6-13, Table 6-2:
Change A5R105 to 0757-0280 RESISTOR 1K 1% .125W F TC=0±100.
Change A5R112 to 0698-3157 RESISTOR 19.6K 1% .125W F TC=0±100.

Service Sheet 6 (schematic):
Change the value of A5R105 to 1kΩ.

Service Sheet 7 (schematic):
Change the value of A5R112 to 19.6kΩ.

CHANGE H

NOTE

See paragraph 7-9 for recommended instrument modification.

Page 6-5, Table 6-2:
Change A1MP70 to 08654-00029.
Change A1MP75 to 08654-20051.
Change A1R2 to 2100-3458.

CHANGE I

Page 1-4, Table 1-1:
Under **MODULATION CHARACTERISTICS** for **Frequency Modulation**, replace **Sensitivity Accuracy** and **Indicated FM Accuracy** specifications with the following:
Sensitivity Accuracy (15° to 35°C)[2] : ±10%. For 100 kHz deviation range above 130 MHz, ±13%.
Indicated FM Accuracy (15° to 35°C)[2] : ±(10% of reading +3% of full scale). For 100 kHz deviation range above 130 kHz, add 3% of reading.

Page 4-22, paragraph 4-26:
Under **SPECIFICATION**, replace **Sensitivity Accuracy** and **Indicated FM Accuracy** specifications with the following:
Sensitivity Accuracy (15° to 35°C)[2] : ±10%. For 100 kHz deviation range above 130 MHz, ±13%.
Indicated FM Accuracy (15° to 35°C)[2] : ±(10% of reading +3% of full scale). For 100 kHz deviation range above 130 kHz, add 3% of reading.

Page 4-24, paragraph 4-26:
Change the last sentence in step 7 to read:
Voltmeter should read between 20.1 and 24.6 mVrms (31.6 mVpk ±10% which corresponds to 31.6 kHz ±10% frequency deviation).

CHANGE I (Cont'd)

Page 4-24, paragraph 4-26: (Cont'd)

In the table following step 7, change the lower voltmeter limits to 20.1 mVrms and the upper voltmeter limits to 24.6 mVrms.

Replace step 8 with the following:

8. Set FM RANGE to 100 kHz and continue using the settings listed below. For frequencies below 130 MHz the voltmeter should read between 63.6 and 77.8 mVrms (100 mVpk ±10% which corresponds to 100 kHz ±10% frequency deviation). For frequencies above 130 MHz, the voltmeter should read between 61.5 and 79.9 mVrms (100 mVpk ±13% which corresponds to 100 kHz ±13% frequency deviation).

Page 4-25, paragraph 4-26:

In the first table, make the following changes:

For the 66—130 MHz range, change the lower voltmeter limits to 63.6 mVrms and the upper limits to 77.8 mVrms.

For the 130—270 MHz and 270—520 MHz ranges, change the lower voltmeter limits to 61.5 mVrms and the upper voltmeter limits to 79.9 mVrms.

Replace step 10 with the following:

10. Continue as before using the following settings. For frequencies above 130 MHz, the voltmeter should read between 59.4 and 82.0 mVrms (100 mVpk ±16% frequency deviation). For frequencies below 130 MHz, the voltmeter should read between 61.5 and 79.9 mVrms (100 mVpk ±13% which corresponds to 100 kHz ±13% deviation).

In the table below step 10, make the following changes:

For the 130-270 MHz and the 270-520 MHz ranges, change the lower voltmeter limits to 59.4 mVrms and the upper voltmeter limits to 82.0 mVrms.

For the 66-130 MHz range, change the lower voltmeter limits to 61.5 mVrms and the upper voltmeter limits to 79.9 mVrms.

Replace step 11 with the following:

11. Set FM RANGE (kHz) to 30 kHz. If necessary adjust FM LEVEL to maintain a panel meter reading of 10 on the 10 scale which corresponds to 31.6 kHz deviation as read on 3 scale. Continue using settings listed below. Voltmeter should read between 19.5 and 25.3 mVrms (31.6 mVpk ±13% which corresponds to 31.6 kHz ±13% deviation).

Page 4-26, paragraph 4-26:

In the table, change the lower voltmeter limit to 19.5 mVrms and the upper voltmeter limit to 25.3 mVrms.

7-7. INSTRUMENT IMPROVEMENT MODIFICATIONS

7-8. Hewlett-Packard has developed certain recommended instrument modifications that can be used to improve the performance and reliability of earlier versions of the 8654B. In some cases, replacing certain parts requires a modification to make these instruments compatible with parts now in use (if the original part is no longer available). These modifications are outlined in the following procedures and are keyed to instruments by serial number prefix.

7-9. Frequency Tune Potentiometer A1R2, Bracket A1MP70 or Pulley A1MP75 Replacement (Serial Numbers 1638A00935 and Below)

7-10. In instruments with serial numbers 1638-00935 and below, if potentiometer A1R2 fails or if bracket A1MP70 requires replacement, all three parts (A1R2, A1MP70, and A1MP75) must be replaced at the same time. Order the following part numbers:

Reference Designation	Part Number	Description
A1MP70	08654-00056	Potentiometer Mount Bracket
A1MP75	08654-20091	Potentiometer Drive Pulley
A1R2	2100-3649	10k Ohm Potentiometer

7-11. Preliminary FM Adjustment D Adjustment Range Improvement (Serial Prefixes 1633A and Below)

7-12. On instruments with serial prefixes 1633A or below, when performing the Preliminary Adjustments, insufficient adjustment range may be observed on FM adjustment D. The adjustment range may be increased by changing A5R105 to 825 ohms, 0.25W (HP 0757-0280).

7-13. +52.1V Regulator Stability Improvement (Serial Prefixes 1633A and Below)

7-14. On instruments with serial prefixes 1633A or below, the +52.1 V power supply may fail to regulate properly or may show excessive line ripple at low line voltages. This condition may be repaired by changing A5R112 to 8250 ohms, 0.25W (HP 0757-0441).

7-15. Frequency Modulation Level Vernier Improvement (Serial Prefixes 1612A and Below)

7-16. On instruments with serial number prefixes 1612A and below, if the frequency modulation level vernier pot is changed, proper smoothness of operation may be difficult to obtain. The addition of a compression spring (HP 1460-0036) on the concentric shaft ahead of the shaft coupler will improve the smoothness of operation of the vernier.

7-17. -10V Regulator Stability Improvement (Serial Prefixes 1550A and Below)

7-18. On instruments with serial prefixes 1550A or below, unwanted sidebands (at approximately 200 kHz) may appear on the RF signal at output levels near +10 dBm. These may be a result of oscillation of the -10V supply. The performance of the -10V power supply exhibiting the above symptoms may be improved by changing A3R7 to 2.7 ohms, 0.25W (HP 0683-0275).

7-19. Meter Switch Coupler Shaft Bushing Bracket Improvement (Serial Prefixes 1531A and Below)

7-20. In instruments with serial prefixes 1531A and below, if the METER switch loses the top and bottom rotation stops, an improved coupler shaft bushing bracket may be installed by following the procedure outlined below.

a. Order the following parts:

Part Number	Qty.	Description
08654-20088	1	Coupler Shaft Bushing Bracket
3050-0010	4	Flat Washers
1480-0008	2	Roll Pins

b. Remove old bracket (MP62).

c. Remove coupler shaft bushing from old shaft.

d. Insert bushing into new bracket.

e. Insert two roll pins into new bracket.

f. Mount new bracket using two washers on each mounting stud to shim the bracket away from the subpanel.

SERVICE INFO

SECTION VIII
SERVICE

8-1. INTRODUCTION

8-2. This section contains instructions for troubleshooting and repairing the Signal Generator.

8-3. Principles of operation and troubleshooting information are located opposite the schematics on the numerical Service Sheets. Service Sheet A contains an illustrated parts breakdown of the A1 RF Section Assembly. The last foldout in this manual has top and bottom internal views of the instrument showing the locations of the major assemblies, test points, adjustments, and some of the chassis parts.

8-4. The rest of this section has general service information that should help you to quickly service and repair the Signal Generator.

8-5. SAFETY CONSIDERATIONS

8-6. Although this instrument has been designed in accordance with international safety standards, this manual contains information and warnings which must be followed to ensure safe operation and to retain the instrument in a safe condition (see Safety Considerations page in the front of the manual). Service and adjustments should be performed only by qualified service personnel.

WARNINGS

Any interruption of the protective (grounding) conductor inside or outside the instrument or disconnection of the protective earth terminal is likely to make the apparatus dangerous. Intentional interruption is prohibited.

Any adjustment, maintenance, and repair of the opened instrument under voltage should be avoided as much as possible and, when inevitable, should be carried out only by a skilled person who is aware of the hazard involved.

Removal of the top cover makes accessible hazardous voltage in the region of connector XA5 (~ 53 Vrms) and on the A5 FM Driver Board (~50 Vdc). Removal of the bottom cover makes accessible hazardous voltage at connector XA5 (~53 Vrms). Removal of the protective cover on the A4 Line Module exposes hazardous voltage (line voltage) at the module's terminals.

Capacitors inside the instrument may still be charged even if the instrument has been disconnected from its source of supply.

Make sure that only fuses with the required rated current and of the specified type (normal blow, time delay, etc.) are used for replacement. The use of repaired fuses and the short-circuiting of fuseholders must be avoided.

Whenever it is likely that the protection has been impaired, the instrument must be made inoperative and be secured against any unintended operation.

8-7. PRINCIPLES OF OPERATION

8-8. Principles of operation appear on the foldout pages opposite the block diagrams and the schematics on the Service Sheets. Service Sheet 1 is an overall block diagram that briefly describes overall instrument operation. It is keyed, by the numbers in the lower right-hand corners of the blocks, to the schematic diagrams on the Service Sheets that follow. It provides an assembly-by-assembly description of instrument operation.

NOTE

Table 8-2, Schematic Diagram Notes, explains any unusual symbols that appear on the schematics. The table also explains the switch-wafer numbering system.

8-9. TROUBLESHOOTING

8-10. This manual provides two methods to isolate a problem to a particular assembly. The first method is to use the results of the performance tests (given in Section IV) and the table of Post-Repair

TROUBLESHOOTING (Cont'd)

Performance Tests and Adjustments, found in Section V. More information about this method is given in Section V.

8-11. Overall Troubleshooting. The second, and primary, troubleshooting method is to use the troubleshooting block diagram (found on Service Sheet 1) to isolate a problem to a particular assembly or circuit.

8-12. Circuit-Level Troubleshooting. Once a problem has been isolated to a particular assembly or circuit, the text opposite the service sheet that documents the circuit gives detailed troubleshooting information for the circuit.

8-13. RECOMMENDED TEST EQUIPMENT

8-14. Test equipment and test equipment accessories required to maintain the Signal Generator are listed in Table 1-2. Equipment other than that listed may be used if it meets the listed critical specifications.

8-15. SERVICE AIDS

8-16. Pozidriv Screwdrivers. Many screws in the instrument appear to be Phillips, but are not. To avoid damage to the screw slots, Pozidriv screwdrivers should be used.

8-17. Service Kit. The following parts can be ordered for use in a service kit for the generator. (Before ordering, check to ensure that they are not on hand; most of them are common to service kits for other Hewlett-Packard instruments.)

1	SMC Adapter	HP 1250-0827
2	Test Cables SMC to BNC . .	HP 11592-60001
1	Extender Board 30 pins . . .	HP 08640-60036

8-18. Extender Board. An extender board is available that can be used to extend the A3 Control/Power Supply Board as shown in Figure 8-1. The part number is HP 08640-60036.

8-19. Wrench. A wrench is supplied with the generator. One end fits 7/32-inch connectors while the other end fits 1/4-inch connectors.

8-20. Part Location Aids. The locations of some chassis-mounted parts and the major assemblies are shown on the last foldout in this manual. In addition, illustrated parts breakdowns located in Section VI and the alphabetical Service Sheets in Section VIII facilitate the identification of mechanical parts. The locations of individual components mounted on printed circuit boards or other assemblies are shown on the appropriate schematic diagram page or on the page opposite it. The part reference designator is the assembly designator plus the part designator (for example, A3R9 is R9 on the A3 assembly). For specific component description and ordering information, refer to the parts list in Section VI.

8-21. Servicing Aids on Printed Circuit Boards. The servicing aids include test points, transistor and integrated circuit designations, adjustment callouts and assembly stock numbers.

8-22. REPAIR

8-23. Factory-Selected Components

8-24. Some component values are selected at the time of final checkout at the factory (see Table 5-1). Usually these values are selected to provide optimum compatibility with associated components. These components are identified on individual schematics by an asterisk (*). The recommended procedure for replacing a factory-selected part is as follows:

a. Try the same value as the component just removed, then perform the calibration test specified for the circuit in the performance and adjustment sections of this manual.

b. If calibration cannot be accomplished, try the typical value shown in the parts list and repeat the test.

c. If the test results are still not satisfactory, substitute various values within the tolerances specified in Table 5-1, until the desired result is obtained.

8-25. Etched Circuits

8-26. The etched circuit boards in the Signal Generator are of the plated-through type consisting of metallic conductors bonded to both sides of insulating material. The metallic conductors are extended through the component mounting holes by a plating process. Soldering can be done from either side of the board with equally good results. Table 8-1 lists recommendations and precautions pertinent to etched circuit repair work.

Etched Circuits (Cont'd)

a. Avoid unnecessary component substitution; it can result in damage to the circuit board and/or adjacent components.

b. Do not use a high-power soldering iron on etched circuit boards. Excessive heat may lift a conductor or damage the board.

c. Use a suction device (Table 8-1) or wooden toothpick to remove solder from component mounting holes. DO NOT USE A SHARP METAL OBJECT SUCH AS AN AWL OR TWIST DRILL FOR THIS PURPOSE. SHARP OBJECTS MAY DAMAGE THE PLATED-THROUGH CONDUCTOR.

d. After soldering, remove excess flux from the soldered areas and apply a protective coating to prevent contamination and corrosion. See Table 8-1 for recommendation.

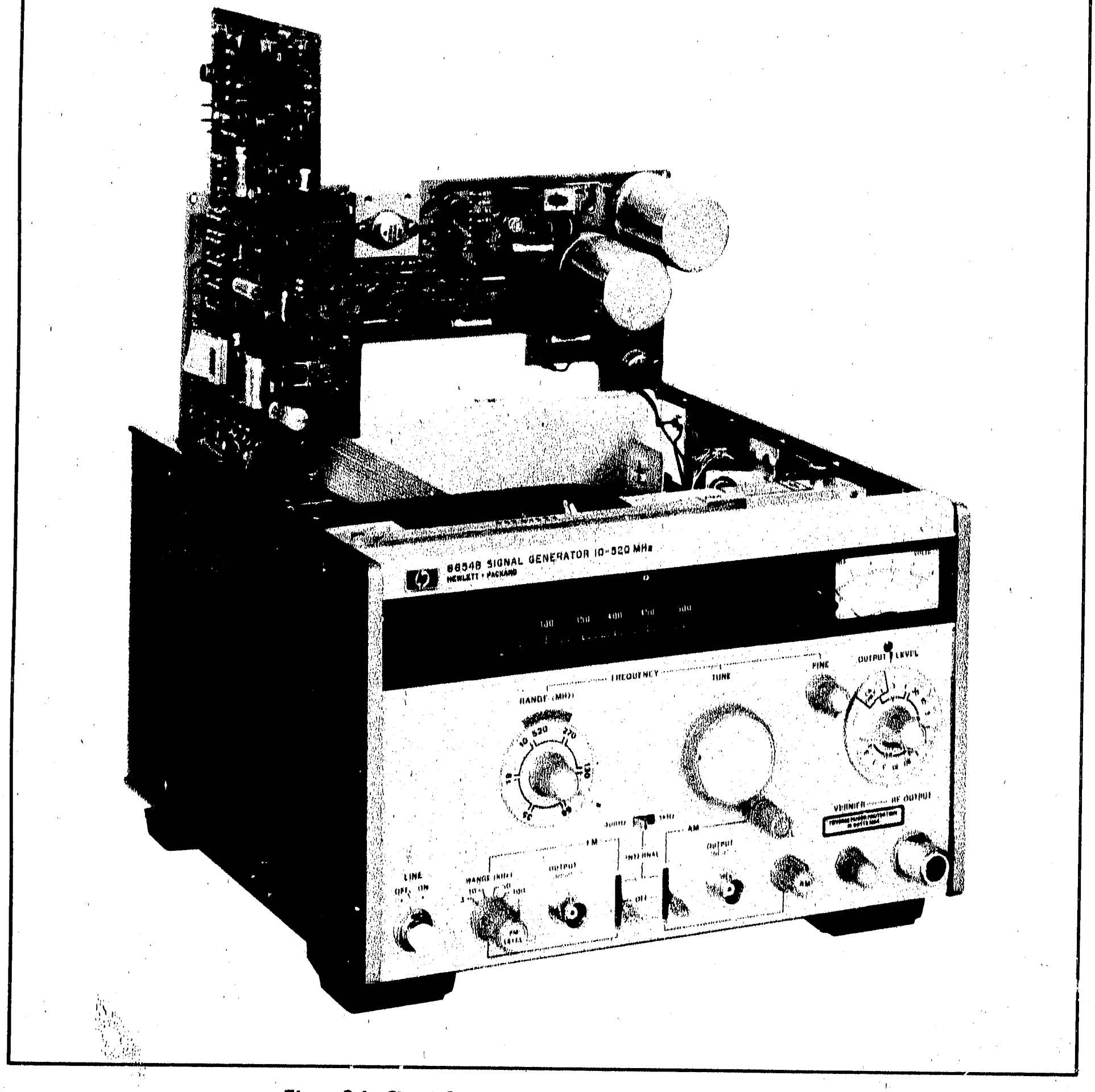


Figure 8-1. Signal Generator With Circuit Board on Extender

8-27. Etched Conductor Repair

8-28. A broken or burned section of conductor can be repaired by bridging the damaged section with a length of tinned copper wire. Allow adequate overlay and remove any varnish from etched conductor before soldering wire into place.

8-29. Component Replacement

8-30. Remove defective component from board.

NOTE

Although not recommended on boards with high-frequency signals or where both sides of a board are accessible, axial lead components, such as resistors and tubular capacitors, can be replaced without unsoldering. Clip leads near body of defective component, remove component and straighten leads left in board. Wrap leads of replacement component one turn around original leads. Solder wrapped connection and clip off excess lead.

8-31. If component was unsoldered, remove solder from mounting holes, and position component as original was positioned. DO NOT FORCE LEADS INTO MOUNTING HOLES; sharp lead ends may damage plated-through conductor.

8-32. Transistor Replacement. Transistors are packaged in many physical forms. This sometimes results in confusion as to which lead is the collector, which is the emitter, and which is the base. Figure 8-2 shows typical epoxy and metal case transistors and the means of identifying the leads.

8-33. To replace a transistor, proceed as follows:

a. Do not apply excessive heat; see Table 8-1 for recommended soldering tools.

b. If possible, use long-nose pliers between transistor and hot soldering tools.

c. When installing replacement transistor, ensure sufficient lead length to dissipate soldering heat by using about the same length of exposed lead as used for original transistor.

d. Integrated circuit replacement instructions are the same as those for transistors.

8-34. Some transistors are mounted on heat sinks for good heat dissipation. This requires good thermal contact with mounting surfaces. To assure good thermal contact for a replacement transistor, coat both sides of the insulator with Dow Corning No. 5 silicone compound or equivalent before fastening the transistor to the chassis. Dow Corning No. 5 compound is available in 8 oz. tubes from Hewlett-Packard; order HP 8500-0059.

8-35. Diode Replacement. Solid state diodes have many different physical forms. This sometimes results in confusion as to which lead is the anode (positive), since not all diodes are marked with the standard symbols. Figure 8-2 shows examples of some diode marking methods. If doubt exists as to polarity, an ohmmeter may be used to determine the proper connection. It is necessary to know the polarity of the ohms lead with respect to the common lead for the ohmmeter used. (For the HP Model 410B Vacuum Tube Voltmeter, the ohms lead is negative with respect to the common; for the HP Model 412A DC Vacuum Tube Voltmeter the ohms lead is positive with respect to the common). When the ohmmeter indicates the least diode resistance, the cathode of the diode is connected to the ohmmeter lead which is negative with respect to the other lead.

NOTE

Replacement instructions are the same as those listed for transistor replacement.

8-36. Illustrated Parts Breakdowns

8-37. An illustrated parts breakdown for the A1 RF Section Assembly is given on Service Sheet A. It is keyed to disassembly and removal instructions (given on the alphabetical service sheets) and to the replaceable parts list given in Section VI. In addition, Section VI contains illustrated parts breakdowns for the cabinet parts and front panel mechanical parts.

8-38. BASIC CIRCUIT THEORY

8-39. Operational Amplifier. Figure 8-3 shows a typical operational amplifier. Circuit A is a non-inverting buffer amplifier with a gain of 1. Circuit B is a non-inverting amplifier with gain determined by the impedance of R1 and R2. Circuit C is an inverting amplifier with gain determined by R2 and R1. Circuit D shows typical circuit connections and parameters. It is assumed that the amplifier has high gain (A very large), low output impedance (R_{OUT} very small), and high input impedance (Zin very large).

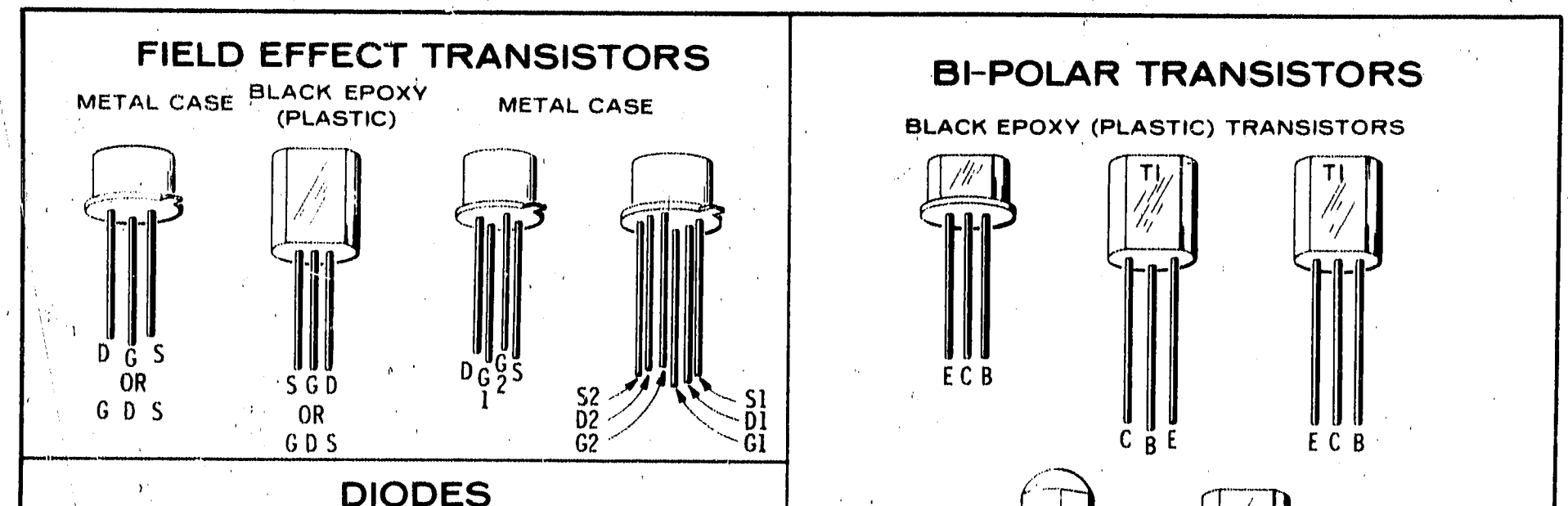


Figure 8-2. Examples of Diode and Transistor Marking Methods

Table 8-1. Etched Circuit Soldering Equipment

Item	Use	Specification	Item Recommended
Soldering tool	Soldering, unsoldering	Wattage range: 37-50; Tip Temp: 750-800°	Ungar #766 handle w/*Ungar #1237 heating unit
Soldering Tip	Soldering, unsoldering	*Shape: pointed	*Ungar #PL111
De-soldering Aid	To remove molten solder from connection	Suction device	Soldapullt by Edsyn Co., Arleta, California
Resin (flux) Solvent	Remove excess flux from soldered area before application of protective coating	Must not dissolve etched circuit base board	Freon; Acetone; Lacquer Thinner
Solder	Component replacement Circuit board repair Wiring	Resin (flux) core, high tin content (60/40 tin/lead), 18 gauge (SWG) preferred	—— ——
Protective	Contamination, corrosion protection	Good electrical insulation; corrosion-prevention properties	Silicone Resin such as GE DRI-FILM**88

* For working on circuit boards: for general purpose work, use Ungar No. 4037 Heating Unit (47½-56½W) tip temperature of 850-900 degrees) and Ungar No. PL113 1/8" chisel tip.

** General Electric Co., Silicone Products Dept., Waterford, New York, U.S.A.

BASIC CIRCUIT THEORY (Cont'd)

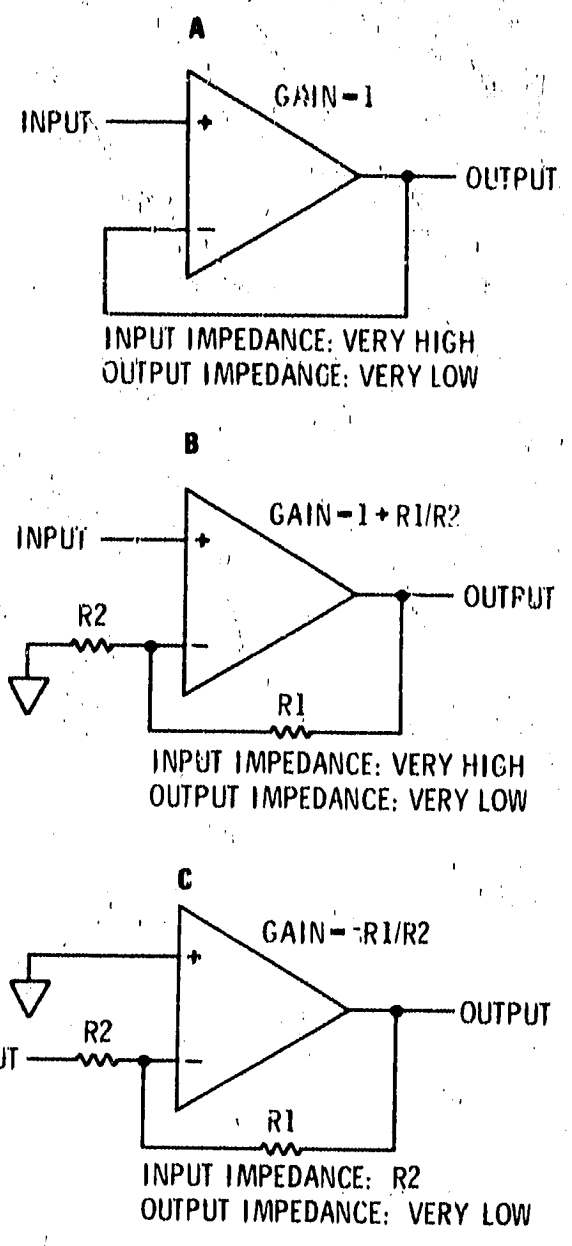
8-40. An operational amplifier can be characterized as an ideal voltage amplifier having low output impedance, high input impedance, and very high gain. Also, the output voltage is proportional to the difference in the voltages applied to the two input terminals. In use, the amplifier output drives the input voltage difference close to zero through a negative feedback path.

8-41. When troubleshooting an operational amplifier, measure the voltages at the two inputs with no signal applied; the difference between these voltages should be less than 10 mV. A difference voltage much greater than 10 mV indicates trouble in the amplifier or its external circuitry. Usually this difference will be several volts and one of the inputs will be very close to an applied circuit operating voltage (for example, +20V, —12V).

8-42. Next, check the amplifier's output voltage. It will probably also be close to one of the applied circuit potentials: ground, +20V, —12V, etc. Check to see that the output conforms to the inputs. For example, if the inverting input is positive, the output should be negative; if the non-inverting input is positive, the output should be positive. If the output conforms to the inputs, check the amplifier's external circuitry. If the amplifier's output does not conform to its inputs, it is probably defective.

8-43. Comparator. Comparators are used as sense amplifiers, pulse height discriminators, and voltage comparators. A voltage reference is connected to one of the amplifier's inputs as shown in Figure 8-4. When the input signal voltage crosses the reference, the output goes positive; the output remains positive until the signal re-crosses the reference.

OPERATIONAL AMPLIFIER



IF "A" IS LARGE, $V_F = V_1$

(1) $$V_0 = V_1 \left(1 + \frac{R1}{R2}\right) - V_2 \left(\frac{R1}{R2}\right)$$

(2) IF $V_2 = 0$ (▽), THEN $$V_0 = V_1 \left(1 + \frac{R1}{R2}\right)$$

(3) IF $V_1 = 0$ (▽), THEN $$V_0 = -V_2 \left(\frac{R1}{R2}\right)$$

Figure 8-3. Operational Amplifier

COMPARATOR

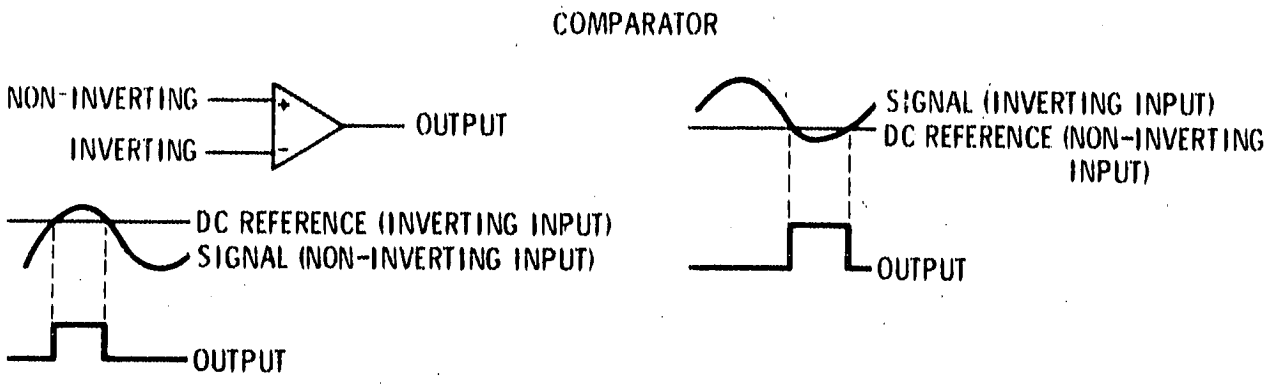


Figure 8-4. Comparator

Table 8-2. Schematic Diagram Notes (1 of 2)

SCHEMATIC DIAGRAM NOTES

Resistance in ohms, capacitance in microfarads, inductance in microhenries unless otherwise noted.

* Asterisk denotes a factory-selected value. Value shown is typical. Part may be omitted.

Tool-aided adjustment.

Manual Control

Encloses front-panel designation.

Encloses rear-panel designation.

Circuit assembly borderline.

Other assembly borderline. Also used to indicate mechanical interconnection (ganging).

Heavy line with arrows indicates path and direction of main signal.

Heavy dashed line with arrows indicates path and direction of main feedback.

Coaxial or shielded cable.

Relay Contact moves in direction of arrow when energized.

CW

Wiper moves toward CW with clockwise rotation of control (as viewed from shaft or knob).

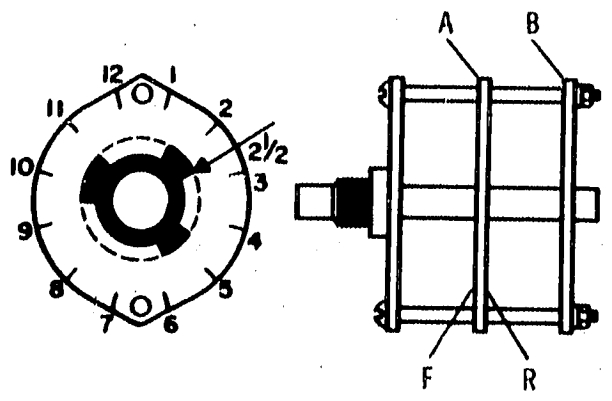
EXAMPLE: A3S1AR(2-1/2)

A3S1 = SWITCH S1 WITHIN ASSEMBLY A3

A = 1st WAFER FROM FRONT (A = 1st, ETC)

R = REAR OF WAFER (F = FRONT)

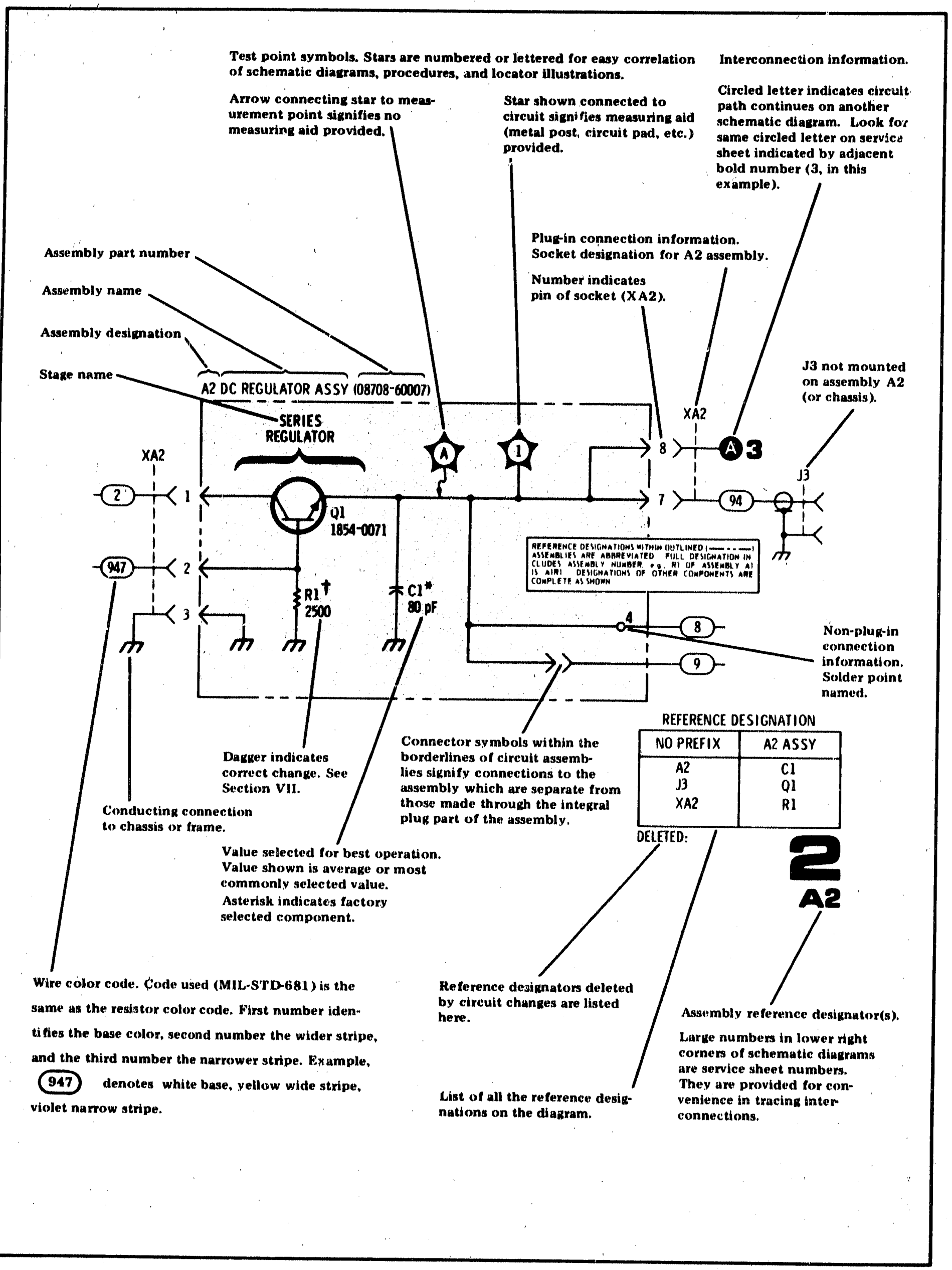
(2-1/2) = TERMINAL LOCATION (2-1/2) (VIEWED FROM FRONT)



A direct conducting connection to the earth, or a conducting connection to a structure that has a similar function (e.g., the frame of an air, sea, or land vehicle).

Common connections. All like-designated points are connected.

Table 8-2. Schematic Diagram Notes (2 of 2)



SERVICE SHEET 1

PRINCIPLES OF OPERATION

General

The Hewlett-Packard Model 8654B is a mechanically-tuned solid-state signal generator producing RF signals covering 10 to 520 MHz in 6 ranges. The output is leveled and continuously variable over a 13 dB range. Attenuation of the RF output signal is controlled in 10 dB steps from +10 to −130 dBm. In addition, calibrated amplitude and frequency modulation are provided including the option of selecting the drive signal from the internal or an external audio source.

RF Oscillator/FM Modulator Circuits

The RF source of the Signal Generator is an LC oscillator. Six frequency ranges are selected by switching tank circuit inductors (FREQUENCY RANGE MHz switch). A variable capacitor (FREQUENCY TUNE control) provides tuning across individual ranges. Varactor diodes parallel to the tuning capacitor provide electronic fine tuning (FINE TUNE control), frequency modulation, and phase-lock control through a rear panel connector.

RF Amplifier/ALC Circuits

A Buffer Amplifier isolates the oscillator from the Modulator (a rear panel auxiliary output is taken from the Buffer Amplifier output). The Modulator is a current-controlled RF attenuator which sets the RF level and applies amplitude or pulse modulation to the RF signal. A Power Amplifier increases the level of the RF signal from the Modulator. The output is coupled to the RF Detector and Attenuator Assembly (OUTPUT LEVEL switch). The RF Detector produces a dc output which is proportional to the RF signal level. The AM/ALC Amplifier compares the RF Detector output with an ALC reference voltage (controlled by VERNIER). An error voltage sets the Modulator's drive current which causes the RF signal level to track the dc reference voltage. When the ALC reference voltage has a superimposed audio signal, the RF signal is amplitude modulated.

Reverse Power Protection

The Reverse Power Protection circuit (Option 003 only) has a relay to open the RF signal path if excessive power is applied to the RF OUTPUT connector. In this manner, the generator's output circuitry is protected. The relay automatically closes to restore generator operation when reverse power has been removed. (The relay is also open when the LINE switch is set to OFF.)

Control Circuits

An Audio Oscillator is enabled when either the AM or FM switch is set to INTERNAL. The 400 Hz/1 kHz switch selects the modulation rate. The audio signal is either switched to to AM or FM OUTPUT/INPUT connectors, or passed through an Audio Amplifier to the internal AM or FM circuits (a mechanical interlock prevents simultaneous internal AM and FM).

During FM operation, the audio signal level (either internal or external) is adjusted by the FM LEVEL control. The signal is then coupled to an FM Driver (Service Sheet 6).

During AM operation, the audio signal level (either internal or external) is adjusted by the AM LEVEL control. A Level Reference Amplifier sums the audio signal with a constant dc level and produces a negative ALC reference voltage.

The output level VERNIER adjusts the reference voltage (with or without AM) to vary the RF signal within a 13 dB range. On all output level ranges but +10 dBm, the negative reference voltage is decreased by adding a voltage divider resistor to the Vernier, to produce the first 10 dB of output attenuation. A Shaping Amplifier adds a small amount of distortion to low level ALC signals to compensate for low level non-linearity in the RF Detector. The Shaping Amplifier drives the AM/ALC Amplifier.

The METER switch selects the input signal to a Meter Driver from either the RF or Audio Detectors. The meter provides indications of RF output level, percent AM, or FM peak frequency deviation.

FM Circuits

The Signal Generator is frequency modulated by varying the capacitance in the RF Oscillator tank circuit. The reverse bias of two varactor diodes in parallel to the tuning capacitor is varied at the modulation rate. The amount of deviation depends on the level of reverse bias imposed on the varactors and the total capacitance in the tank.

The DC Shaping Circuit produces a voltage which is a function of the position of the FREQUENCY TUNE control and correspondingly the capacitance

SERVICE SHEET 1 (Cont'd)

in the tank. Since the tuning capacitor does not produce a perfectly linear change in frequency across each range, the dc voltage corresponding to the capacitor tune position is shaped to track frequency. In addition, the frequency change across each range does not perfectly track that of any other range. The DC Shaping circuit also compensates for the variations in frequency tracking between ranges.

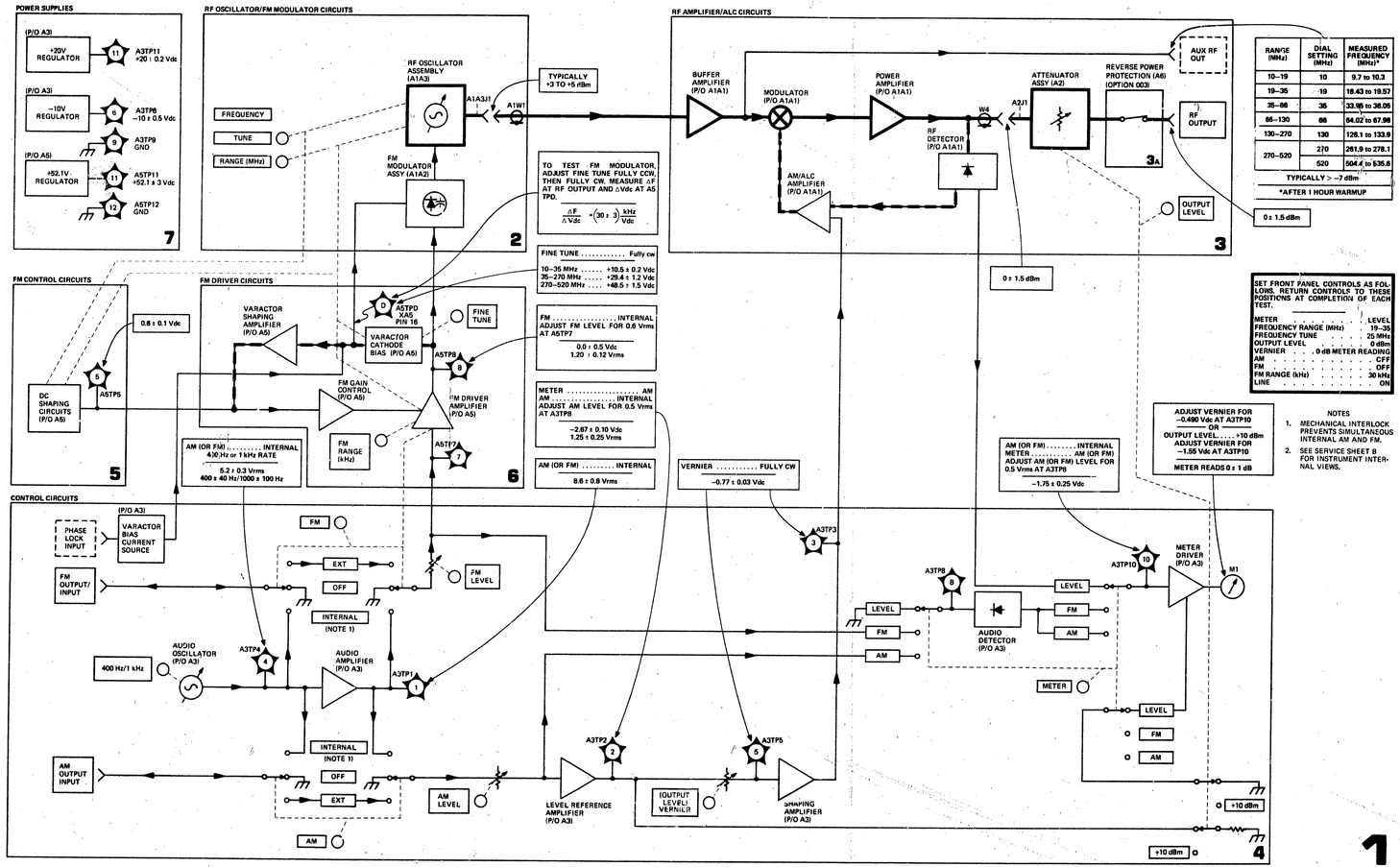
The Varactor Shaping Amplifier compensates for the non-linearity of the voltage-capacitance response of the varactor. The feedback through the Varactor Shaping Amplifier and the output of the DC Shaping Circuits are summed in the FM Gain Control Amplifier. The output of this circuit directly controls the gain of the FM Driver Amplifier.

The FM Driver Amplifier receives the FM input through the FM LEVEL vernier and drives the varactor anode. The voltage imposed onto the varactors is therefore a function of the input voltage, the range of deviation, the frequency range, and the FREQUENCY TUNE position within the range.

TROUBLESHOOTING

Use the troubleshooting block diagram (Service Sheet 1) to isolate the trouble to a specific section of the instrument. Then turn to the service sheet (indicated by bold number in lower right corner of block) and isolate the trouble to the defective component.

When using the troubleshooting block diagram, initially set the generator's controls as indicated in the box at the right of the diagram. Then change the control settings as instructed by the boxes throughout the diagram to make specific measurements. Always return controls to their initial settings after completing a measurement.



RANGE (MHz)	DIAL SETTING (MHz)	MEASURED FREQUENCY (MHz)*
10–19	10	9.7 to 10.3
19–35	19	18.43 to 19.57
35–66	35	33.95 to 36.05
66–130	66	64.02 to 67.98
130–270	130	126.1 to 133.9
270–520	270	261.9 to 278.1
	520	504.4 to 535.6

Figure 8-5. Troubleshooting Block Diagram

SERVICE SHEET 2

PRINCIPLES OF OPERATION

General

The A1A3 RF Oscillator Board Assembly contains the active portion of the RF oscillator, a buffer amplifier, an ALC circuit, and two power supplies. The tuning capacitor and turret inductors constitute the oscillator tank circuit. Two varactor diodes on the A1A2 FM Modulator Assembly electronically tune the oscillator over a narrow range. The varactors implement electronic FINE TUNE, frequency modulation, and phase lock (when used).

RF Oscillator and Tank Circuit (A1A3)

The RF Oscillator is a two-transistor, push-pull LC oscillator with a built-in ALC loop. The output power is relatively constant at +4 dBm over the six frequency ranges, 10 to 520 MHz. Cross-coupled transistors Q1 and Q2 form a positive-feedback amplifier. C3 and C4 couple the output from the collector of one transistor to the base of the second. R7 and R13 prevent parasitic oscillation modes caused by Q1 and Q2. The parallel resonant tank circuit is coupled across the collectors of Q1 and Q2. The frequency of oscillation is set by the tank circuit because the frequency of resonance is also the point at which the circuit impedance is maximum (loop gain is maximum) and phase shift is zero (maximum positive feedback). Tuning capacitor A1C3 provides about one octave of frequency tuning on each range. Tuning Range capacitor C2 (and parallel capacitor C12*) adjusts the high-frequency-to-low-frequency ratio for each range. Switching the turret inductors (A1A4L1 to L6), changes the frequency range.

On the five lowest ranges collector bias current for Q1 and Q2 is supplied from the emitter of transistor Q6 through a resistor (A1A4R1 to R5), and through the center tap of the turret inductor. On the 270—520 MHz range, the resistor is replaced by a short to increase the oscillator output power. Inductive beads A1A4E1, E2, and E3 reduce RF leakage into the power supply. Base voltage for Q1 and Q2 is established by the voltage divider R8 and R9. Current to the emitters of Q1 and Q2 is supplied from current source Q4 through limiting resistor R11. The emitter current is determined by the output of the ALC detector.

The output from the oscillator is taken from the Q1 side of the tank circuit. The output of the Buffer Amplifier Q3 is coupled to the output port and the ALC detector through voltage divider R15 and R16 and coupling capacitor C8. Capacitor C6 filters the oscillator harmonics at high frequencies.

Troubleshooting Block Diagram
SERVICE SHEET 1

SERVICE SHEET 2 (Cont'd)

The peak-to-peak ALC Detector samples the RF output voltage and regulates the emitter current of Q1 and Q2 to provide a leveled output. The peak-to-peak RF voltage swing is maintained at +0.3 to +1.3 Vdc at the node common to CR1 and CR2. The voltage into the detector is ac coupled through C11. Voltage divider R20 and R21 establishes a +1.0 Vdc reference voltage at the cathode of hot carrier diode CR2. CR2 clamps the positive peak of the output signal at +1.3 Vdc (+1.0 Vdc plus the junction drop of CR2). As the voltage swings negative and begins to approach +0.3 Vdc, CR1 begins to conduct. It diverts some of the charging current flowing to C5 and C9 (from R17) and reduces their charge. The voltage across C5 is the base-to-emitter voltage of Q4; therefore the emitter current supplied to oscillator transistors Q1 and Q2, and the RF output level, is regulated by this voltage. The RF voltage will seek a level at the node common to CR1 and CR2, such that the positive peak is clamped to +1.3 Vdc and the negative peak causes enough current flow through CR1 so the voltage across C5 is maintained at a constant level. The latter situation occurs when the negative peak approaches +0.3 Vdc.

Transistors Q6 and Q5 isolate the RF oscillator circuit supplies from the power supply. The output cable shield provides a dc and signal ground path.

FM Modulator Assembly (A1A2)

Varactor diodes CR1 and CR2 are in parallel with the main tuning capacitor A1C3. The diodes are reverse biased at +19 Vdc through resistors R1 and R2 and are coupled into the tank circuit through capacitors C1 and C2. An audio modulation signal is applied at the node common to CR1 and CR2 during frequency modulation.

TROUBLESHOOTING

If microphonics are more pronounced than normal, check the deflection of tuning capacitor contacts. Refer to Turret Assembly installation procedure, step 5, (Service Sheet A). In addition, Service Sheet A and B contain assembly procedures for reducing microphonics.

The output of the A3 RF Oscillator Assembly should be +4 ±2 dBm. If the output is incorrect, short the collector (metal case) of A1A3Q4 to ground to open the ALC feedback path. If the oscillator and buffer amplifier are operating properly, the RF output will rise to about +14 dBm at 10 MHz and will drop to about +11 dBm at 520 MHz.

If oscillator distortion is evident, use an oscilloscope to check the A1A3 RF Oscillator Assembly output (at 10 MHz) with a 50Ω termination and with an open circuit. If the distortion is much greater with the 50Ω termination, A1A3Q3 is probably defective. Otherwise, A1A3Q1 or Q2 may be causing the distortion. If distortion is evident at higher frequencies only, repeat the distortion check using a spectrum analyzer and a high impedance (>500Ω) probe. Distortion from the A2 FM Modulator Assembly may be isolated by unsoldering and lifting one lead each of A1A2 CR1 and CR2 from the circuit board and rechecking the distortion.

The RF Oscillator may continue to operate with one defective transistor. Symptoms are: the RF output is lower than normal and distortion is evident. The defective transistor may be isolated by "turning-off" the good transistor. Connect the base of one transistor to the collector (metal case) of A1A3Q4. If oscillation ceases, the other oscillator transistor is probably defective. If oscillation continues, check the other oscillator transistor by the same method.

NOTES

To prevent leakage, verify that cables and connectors are secure.

Ground the A1A3 RF Oscillator with a jumper wire if it is removed from the chassis for purposes of troubleshooting. It is normally grounded through the RF cables and mounting bracket.

A1A3 ASSEMBLY

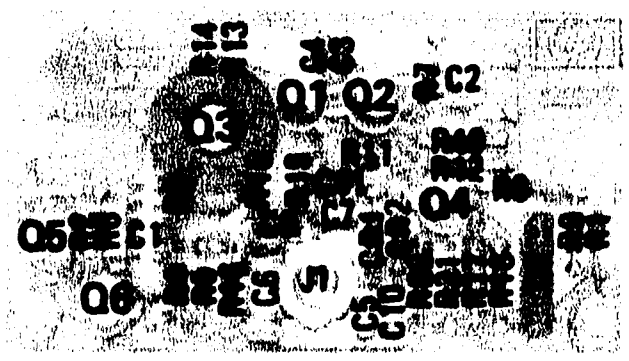


Figure 8-6. A1A3 RF Oscillator Board Assembly Component Locations

A1A4 ASSEMBLY

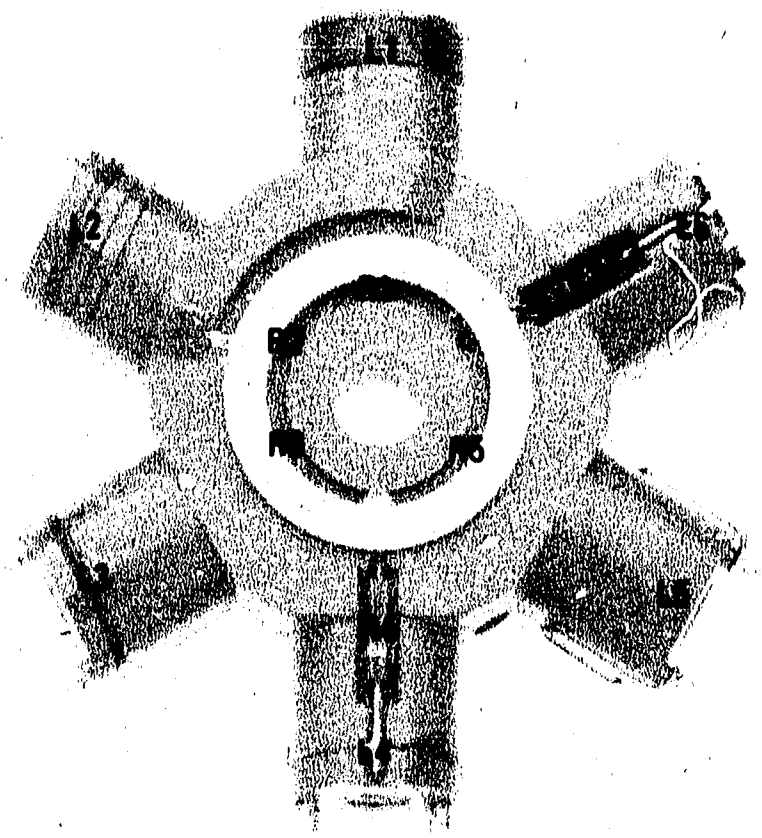


Figure 8-7. A1A4 Turret Assembly Component Locations

A1A2 ASSEMBLY

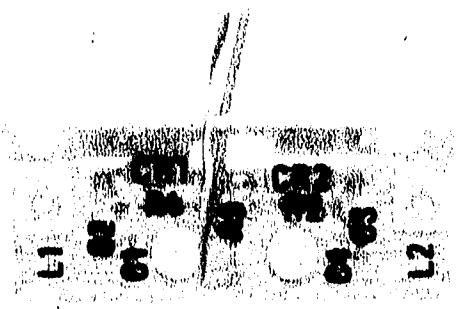
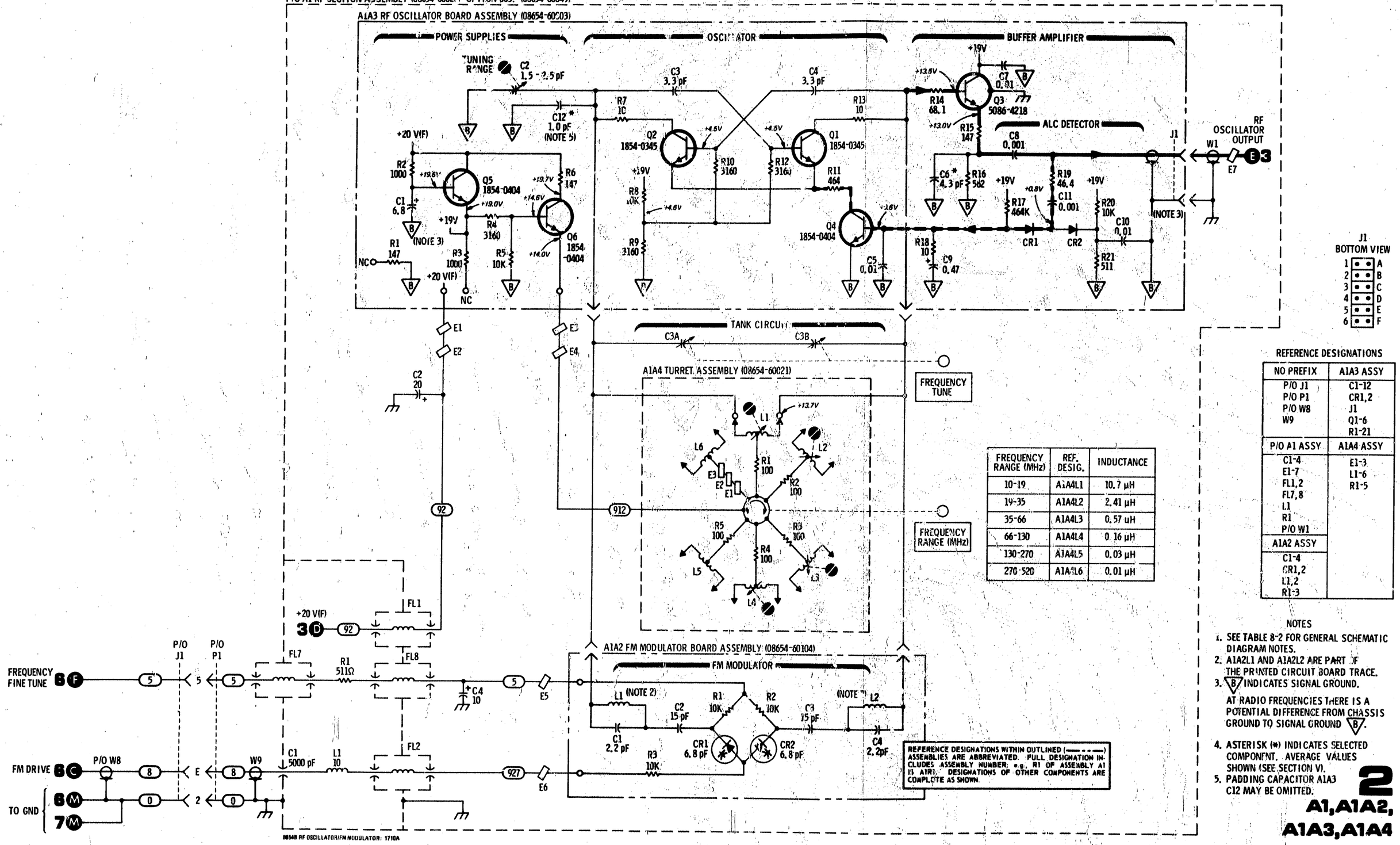


Figure 8-8. A1A2 FM Modulator Board Assembly Component Locations



FREQUENCY RANGE (MHz)	REF. DESIG.	INDUCTANCE
10-19	A1A4L1	10.7 μH
19-35	A1A4L2	2.41 μH
35-66	A1A4L3	0.57 uH
66-130	A1A4L4	0.16 μH
130-270	A1A4L5	0.03 μH
270-520	A1A4L6	0.01 μH

J1
BOTTOM VIEW

1		A
2		B
3		C
4		D
5		E
6		F

REFERENCE DESIGNATIONS

NO PREFIX	A1A3 ASSY
P/O J1 P/O P1 P/O W8 W9	C1-12 CR1,2 J1 Q1-6 R1-21
P/O A1 ASSY	A1A4 ASSY
C1-4 E1-7 FL1,2 FL7,8 L1 R1 P/O W1	E1-3 L1-6 R1-5
A1A2 ASSY	
C1-4 CR1,2 L1,2 R1-3	

NOTES

1. SEE TABLE 8-2 FOR GENERAL SCHEMATIC DIAGRAM NOTES.
2. A1A2L1 AND A1A2L2 ARE PART OF THE PRINTED CIRCUIT BOARD TRACE.
3. (B) INDICATES SIGNAL GROUND. AT RADIO FREQUENCIES THERE IS A POTENTIAL DIFFERENCE FROM CHASSIS GROUND TO SIGNAL GROUND (B).
4. ASTERISK (*) INDICATES SELECTED COMPONENT. AVERAGE VALUES SHOWN (SEE SECTION V).
5. PADDING CAPACITOR A1A3 C12 MAY BE OMITTED.

2
A1,A1A2, A1A3,A1A4

Figure 8-9. RF Oscillator, FM Modulator Schematic Diagram

SERVICE SHEET 3

PRINCIPLES OF OPERATION

Amplifier/ALC Assembly (A1A1)

The RF Amplifier/ALC Assembly contains an RF buffer amplifier, a power amplifier, and the power leveling and amplitude modulation circuits.

Buffer Amplifier

The main function of the Buffer Amplifier is to isolate the RF oscillator from the modulator. The gain of the amplifier is approximately 0 dB. Transistors Q1 to Q4 form the four stages of the amplifier. Transistor Q3 is a common-base amplifier with a 50Ω input. The base of Q3 is biased by voltage divider R3 and R5. L3 and C4 shape the amplifier's frequency response. Q3 drives the common-gate FET stage Q2 which drives the common-base stage Q1 through R7. The base of Q1 is biased by the voltage divider R8 and R10. Q1 drives the emitter follower Q4. The RL network R13, and L4 increases the gain at high frequencies. Q4 drives the modulator diodes; the signal is also coupled to the AUX RF OUT port through R21 and C18.

Power Amplifier

The signal from the modulator is amplified by the Power Amplifier. The amplifier has a nominal low frequency gain of 9 dB with a 1 to 2 dB increase in gain up to 550 MHz and then a rapid roll-off beyond 600 MHz. Transistor Q5 is the input stage and Q6 and Q7 are a push-pull output stage. Q6 is driven from the collector of Q5 and Q7 is driven from the emitter of Q5. The base voltage of Q5 is set by the voltage divider R19 and R20. Emitter current for Q5 is set by resistors R23 and R24. Emitter current for Q7 (and Q6) is set by resistor R28. Networks R22 and L7; R23, R24, and C17; R27 and C19; R30 and C22 shape the frequency response. The power amplifier output is coupled to the attenuator (through C21 and R35) and the RF detector (through C23 and R31).

RF Detector, ALC Amplifier, and Modulator

The RF output level is held constant by the ALC negative feedback loop which is composed of the RF Detector, ALC amplifier, and the Modulator. The RF Detector samples the RF output voltage, and the output is compared to the ALC reference voltage by the ALC Amplifier. The error output of the ALC Amplifier drives the Modulator which, in turn, regulates the RF output to keep the level constant.

RF Oscillator, FM Modulator (A1A2, A1A3, A1A4) SERVICE SHEET 2

SERVICE SHEET 3 (Cont'd)

C23 couples the RF signal into the detector circuit. Q8 is a current source which supplies bias current to both CR5 and CR4. Q9 sinks one half the current of Q8 causing the current through CR4 to equal that of CR5. R39 (DET BIAS) allows these offset currents to be exactly adjusted. This biasing causes any thermal variations in CR5 to be offset by similar variations in CR4. With no RF signal present, CR5 is slightly turned on. When RF enters through C23, CR5 diverts to ground positive excursions greater than +0.4V (one diode junction drop). This causes C24 to change to a negative dc level. The result is a re-referenced RF waveform at CR5 whose peak positive excursion is clamped to one diode junction drop above ground. The RF signal is filtered out by RC networks R32 and C24, and R29 and C20 leaving the dc component at CR4. The voltage drop across CR4 directly offsets that across CR5. The result is a negative dc potential at the cathode of CR4 whose magnitude is directly proportional to the peak RF voltage entering the circuit.

The detector output drives the meter circuits and the ALC Amplifier U1. U1 compares the ALC reference with the detector output. The resultant error output voltage controls the bias current of CR2 and CR3. CR2 and CR3 are PIN diodes whose RF impedance is inversely related to the dc bias current. Inductor L5 is an RF choke which provides a path to ground for the modulator bias current. Resistors R12 and R16 and inductor L6 provide optimum impedance matching for the modulator. Components CR1 and C10 speed up the modulator response time for AM inputs; C9 provides frequency compensation for the ALC loop.

A2 Attenuator Assembly

The output of the power amplifier is coupled to the Attenuator Assembly. The step attenuator consists of resistive attenuator sections which are switched in and out by cam-driven microswitches. The top two ranges are 0 dB and each succeeding step is 10 dB (120 dB maximum) at an impedance of 50Ω. The capacitor couples the output to the RF OUTPUT connector J3 (chassis mounted).

TROUBLESHOOTING

In general, troubleshooting the A1A1 assembly is most easily done with the frequency set to 10 MHz, and with an oscilloscope and high impedance probe.

If the AUX RF OUT is lower than normal (−<7 dBm) and the A1 RF Section Assembly output is +4 ± 2 dBm, check amplifier stages A1A1Q1—4 for proper operation.

If the AUX RF OUT level is correct but the signal input applied to A1A1Q5 is abnormal, check the modulator (A1A1CR2 and CR3) and the modulator drive from A1A1U1.

If the input to A1A1Q5 is normal but the RF OUTPUT level is incorrect, check A1A1Q5—Q7 for proper bias. One transistor failure in the Power Amplifier will often cause another to fail.

NOTE

Verify that cables and connectors are secure. Ground the A1A1 RF Amplifier/ALC Assembly with a jumper wire if they are unsecured for purposes of troubleshooting. It is normally grounded through the RF cables and the casting.

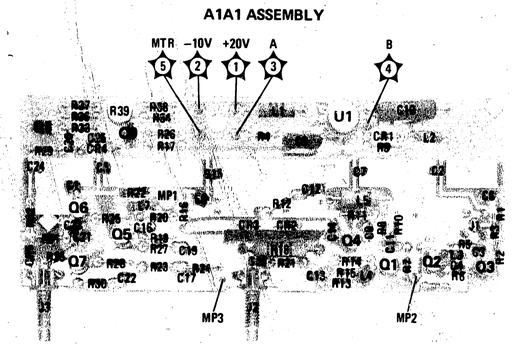


Figure 8-10. A1A1 RF Amplifier/ALC Board Assembly Component Locations

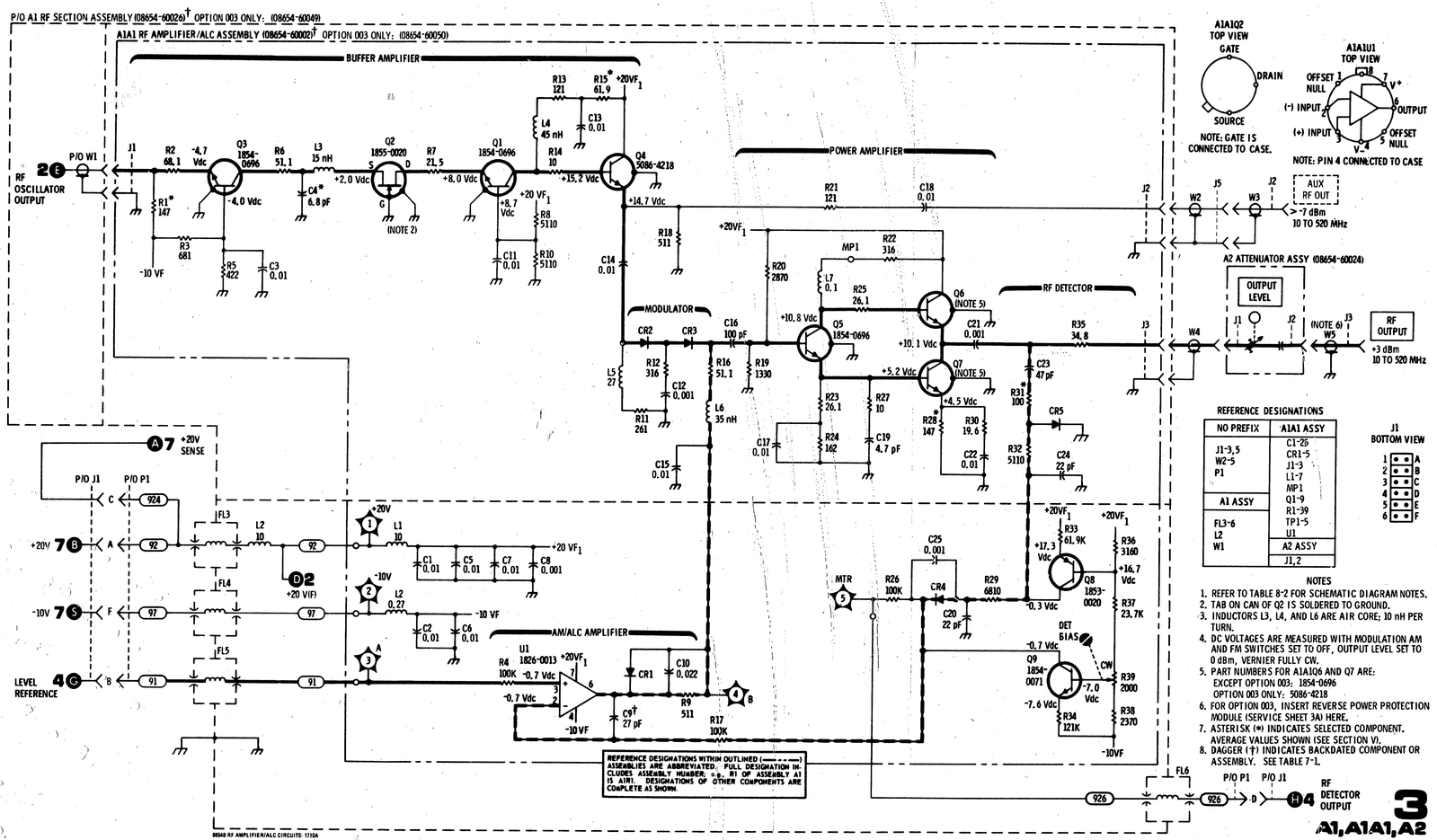


Figure 8-11. RF Amplifier/ALC Assembly Schematic Diagram

SERVICE SHEET 3A (Option 003)

PRINCIPLES OF OPERATION

General

This Service Sheet documents instruments with reverse power protection (Option 003). The Reverse Power Protection circuit opens a relay contact in the RF signal path if excessive power is applied to the output jack A6J2 to prevent damage to the generator's output circuits. During the time required to open the relay (≈ 50 μs), the Limiter maintains a safe signal level at the output circuits of the generator. (With LINE switch set to OFF, the relay contacts are open.)

Detector (A6A1)

The Detector is a peak-to-peak detector which senses the RF level. The signal is first reduced by a capacitive voltage divider to protect the detector against large RF levels. It is formed by C10 and the parallel capacitances of C8, CR4, and CR2 with VR2. During negative excursions of the RF signal, current flows through CR4 and charges C10 to approximately Vpk/8. During positive excursions, the stored charge adds to the signal passed by C10 and passes through detector diode CR2. The detected output is stored in the parasitic capacitance of VR2. VR2 also protects the comparator by limiting the maximum signal applied to the comparator.

Level Sensor and Relay Driver (A6A1)

Normally, the RF output signal passes through relay K1 to the output jack A6J2. K1 is held closed by the action of the Detector, Level Sensor, and Relay Driver. Resistors R1 and R2 set a reference level at the non-inverting input of comparator U1. This reference level is more positive than the normal Detector voltage, so the comparator output is pulled high through resistor R7 (U1 is an open-collector output device requiring an external pull-up resistor). The high level on the base of transistor Q1 biases Q1 and Q2 on, thus energizing relay K1 (closed).

An increased signal level at A6J2 will cause an increased Detector output level. If the level from the Detector exceeds the reference level, the comparator output will switch low. (Resistor R4 provides hysteresis to the comparator input to prevent oscillations and ensure positive switching.) A low level on the base of Q1 will bias Q1 and Q2 off. Relay K1 will de-energize (open) when the collector current of Q2 stops flowing. Collector voltage of Q2 will approach source potential to drive transistor Q3 into conduction which can supply approximately +4V at 50 mA to FL2. When the relay opens, capacitor C11 provides a discharge path for the current induced in the relay coil.

SERVICE SHEET 3A (Cont'd)

When reverse power is removed, the Detector voltage drops below the reference level. The comparator output starts rising toward its high state to close the relay. Capacitor C4 slows the rate of change to decrease relay contact chatter if the reverse power signal is pulsed.

Limiter (A6A1)

The limiter clips any RF voltage imposed on it (from any direction) at approximately 21.2V peak-to-peak as described below.

Assume a reverse power signal entering from RF Output. During the first incoming RF cycle, CR3 clips off any negative signal voltage lower than one diode junction drop. During the following half cycle, capacitors C2 and C6 store a charge that positively offsets the cathode of CR3. This has the effect of re-referencing the subsequent RF signal at CR3 so that its peak negative voltage occurs just one diode junction drop below ground. For example, a 5V p-p signal at J2 has excursions of ±2.5 Vp. The re-referenced signal at CR3 will have a positive excursion of +4.4V and a negative excursion of −0.6V. During the second RF cycle, the anode of CR1 acquires a similar but negative offset. A re-referenced 5 Vp-p signal at CR1 will have a positive excursion of +0.6V and a negative excursion of −4.4V. Once these offsets are established, the sum of the re-referenced in-phase RF signals across VR1 and VR3 is a dc voltage equal to the peak-to-peak RF voltage minus the two diode junction drops of CR1 and CR3. For the 5 Vp-p signal, this voltage from CR1 anode to CR3 cathode, would be approximately +3.8 Vdc, insufficient to cause the zeners to conduct. When this dc voltage exceeds the sum of the breakdown voltages of VR1 and VR2, the limiter symmetrically clips the RF waveform. This occurs at RF inputs greater than 21.2 Vp-p. Note that the limiter acts on RF from either direction, the generator or reverse power.

Capacitors C8, C9, and C10, inductors L1 and L2, and the parasitic capacitances of CR1 and CR3 form a low-pass filter to maintain level flatness of the output signal over the range of the generator. Capacitors C3, C5, and C7, and resistors R5, R8, and R9 prevent RF from entering the Relay Driver.

TROUBLESHOOTING

Troubleshoot the A6 assembly by using the test equipment and following the procedure listed below.

Test Equipment

Digital Voltmeter	HP 34702A/34740A
Oscilloscope	HP182C/1801A/1820C
Test Oscillator	HP 651B
50-Ohm Load	HP 11593A

Limiter

1. With LINE set to OFF, connect test oscillator output to RF IN (FROM ATTEN), A6J1, through a coaxial tee. Connect other port of the tee to an oscilloscope.
2. Set test oscillator to 1 MHz with amplitude turned down. Set oscilloscope to display a 1 MHz signal with 10V per vertical division.
3. Increase test oscillator output level until clipping of the signal appears on oscilloscope. Amplitude of the clipped waveform should be 19 to 23 Vp-p.

Detector

1. With LINE set to OFF, disconnect output cable W11 and connect 50 ohm load to RF OUT (TO FRONT PANEL), A6J2.
2. Orient the Reverse Power Protection Assembly so that comparator A6U1 is accessible.
3. Set OUTPUT LEVEL to +10 dBm range and LINE to ON.
4. Observe dc voltage at pin 3 of A6U1 while adjusting OUTPUT LEVEL over full vernier ranges. The voltage should vary from approximately 50 to 500 mVdc.

Level Sensor, Relay Driver, and Indicator Driver

1. Short pin 2 of comparator A6U1 to ground. The Level Sensor, Relay Driver, and Indicator Driver circuits should switch to "relay-open" conditions (see appropriate dc voltages on schematic).

A6A1 ASSEMBLY

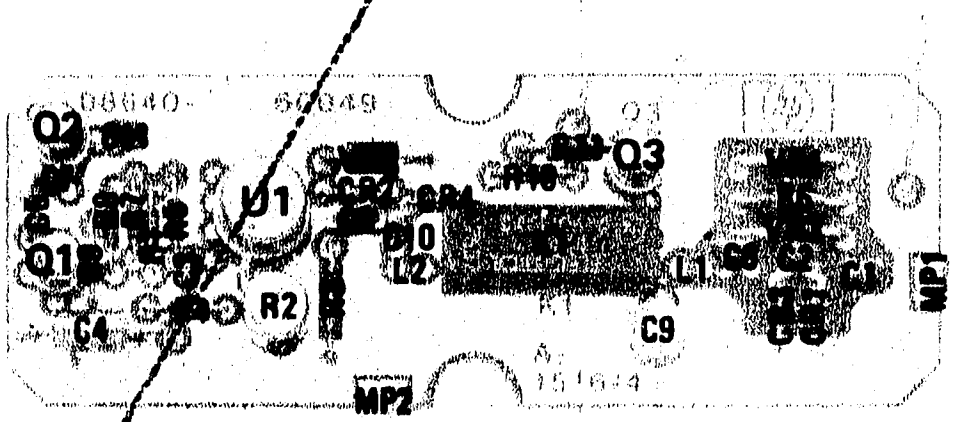
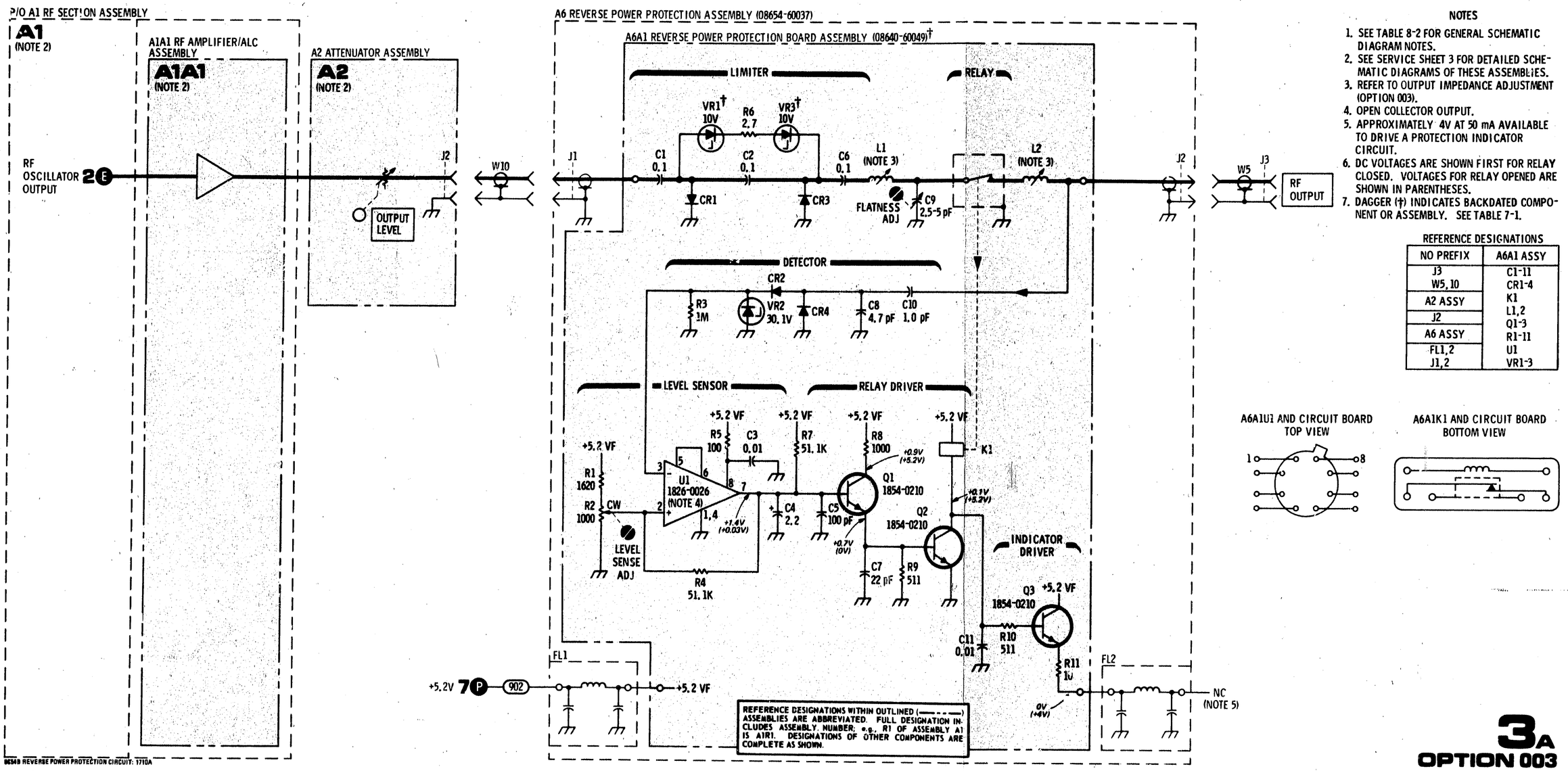


Figure 8-12. A6A1 Reverse Power Protection Board Assembly Component Locations



NOTES

1. SEE TABLE 8-2 FOR GENERAL SCHEMATIC DIAGRAM NOTES.
2. SEE SERVICE SHEET 3 FOR DETAILED SCHEMATIC DIAGRAMS OF THESE ASSEMBLIES.
3. REFER TO OUTPUT IMPEDANCE ADJUSTMENT (OPTION 003).
4. OPEN COLLECTOR OUTPUT.
5. APPROXIMATELY 4V AT 50 mA AVAILABLE TO DRIVE A PROTECTION INDICATOR CIRCUIT.
6. DC VOLTAGES ARE SHOWN FIRST FOR RELAY CLOSED. VOLTAGES FOR RELAY OPENED ARE SHOWN IN PARENTHESES.
7. DAGGER (†) INDICATES BACKDATED COMPONENT OR ASSEMBLY. SEE TABLE 7-1.

REFERENCE DESIGNATIONS

NO PREFIX	A6A1 ASSY
J3 W5, 10	C1-11 CR1-4
A2 ASSY	K1 L1,2
J2	Q1-3
A6 ASSY	R1-11
FL1,2 J1,2	U1 VR1-3

A6A1U1 AND CIRCUIT BOARD TOP VIEW

A6A1K1 AND CIRCUIT BOARD BOTTOM VIEW

3A OPTION 003

Figure 8-13. Reverse Power Protection (Option 003) Assembly Schematic Diagram

SERVICE SHEET 4

PRINCIPLES OF OPERATION

General

The A3 Control/Power Supply Assembly contains the +20 and −10 volt power supplies, the audio modulation oscillator, the ALC level reference amplifier, and the meter circuits. Refer to Service Sheet 7 for information and schematics pertaining to the power supplies.

Audio Oscillator (A3)

When either the AM or FM MODULATION switches are set to INT, the Audio Oscillator is enabled. The oscillator couples a signal of either 400 Hz or 1 kHz (selected by the INTERNAL MODULATION switch) into the AM or FM modulator circuits and to the AM or FM front panel output jacks.

The oscillator consists of U4B and associated components. A frequency-selective modified bridged-tee network forms a negative feedback path. This network, composed of chassis-mounted C1 and A3C16, C19, C20, R20, R21, R22, and R25, is a notch filter with zero phase shift (minimum negative feedback) at the minimum of the notch. The positive-feedback path is a voltage divider in which the amount of feedback is determined by the output of a peak detector. The amount of feedback automatically adjusts to maintain oscillation at a constant output amplitude. The voltage divider consists of R23, CR6, and CR7. Diodes CR6 and CR7 are in ac parallel and dc series. The ac resistance is determined by the dc voltage across capacitor C18. At the peak of each output cycle, VR3 and CR8 conduct and replenish the charge lost from C18. The ac voltage at the output of U4B is approximately 5.2 Vrms. The output is coupled to the AM or FM output jacks, and to the Audio Amplifier U4A.

Audio Amplifier (A3)

The Audio Amplifier U4A increases the level of the internal modulation signal to drive the AM or FM modulator circuits. The signal gain of the amplifier is about 1.7. The output drives the modulation level potentiometers. For internal FM, the signal is coupled to the FM Preamplifier (Service Sheet 6). For internal AM, the signal is coupled through R34 to the Level Reference Amplifier.

Reverse Power Protection Assembly (A6)
SERVICE SHEET 3A

SERVICE SHEET 4 (Cont'd)

Level Reference Amplifier (A3)

The Level Reference Amplifier U1 sums the ALC reference current (supplied by the +20 volt supply through R36) and the AM signal current (either external or from the audio amplifier). The sum of the two currents flows through R37 and generates the negative level reference voltage. The amplifier output drives the AM detector and is coupled to the VERNIER control R5 (chassis mounted). On the +10 dBm OUTPUT LEVEL range, R7 (chassis mounted) is switched out. The ALC reference to the modulator is increased by 10 dB. The output power increases by 10 dB, but AM depth is limited by the maximum output power available. Diodes CR9 and CR10 protect the Level Reference Amplifier input.

Shaping Amplifier (A3)

The Shaping Amplifier U5 pre-distorts low level inputs to compensate for non-linearities in the RF detector at low RF levels. The amplifier gain is near unity. The signal level at the non-inverting (+) input of U5 is normally negative enough to turn off diode CR15 and thus CR15 has no effect. For small negative signal levels CR15 is turned on slightly, the input impedance is lowered, and the overall gain reduced. The point at which CR15 turns on is set by the current established by R52 and R49. Diode CR16 thermally compensates CR15. The DIST ADJ control R52 is set for minimum AM distortion at a low ALC reference level. The shaping amplifier drives the AM/ALC amplifier (Service Sheet 3).

Audio Detector (A3)

The Audio Detector is a negative peak detector which samples the negative ac peak of the incoming AM or FM modulation signal and stores the voltage on a capacitor. The detector output is proportional to the AM depth or FM deviation. Amplifier U3A is used as a voltage comparator. When the voltage at pin 3 is more negative than the voltage at pin 2; the output rapidly switches to a level equal to the voltage across capacitor C28 (which is connected to pin 2 through R44 and R45) minus the voltage drop across the forward-biased diode CR14. The amplifier discharges C28 until the voltage at pin 2 equals the voltage at pin 3, and maintains this condition until the voltage at pin 3 rises. The amplifier then switches positive and slowly charges C28 through resistors R44 and R45 until the voltage at pin 3 becomes more negative than pin 2. Thus, the negative peak value of the input voltage is stored on C28. Resistor R41 adds a small amount of gain to the detector because R41 and R44 and R45 form a voltage divider. The detector drives the meter driver amplifier when the METER switch is set to AM or FM.

Meter Driver (A3)

The Meter Driver U3 provides an output current to panel meter M1 proportional to the input voltage. The input is either the RF detector output (proportional to RF output voltage) or the Audio Detector output. The voltage at pin 5 is equal to that at pin 6. The voltage at pin 6 establishes the current through resistors R57, R58, and R59 (and R53 when grounded). The current flowing through these resistors also flows through the meter to the amplifier output. R51 varies the amplifier gain, and R54 varies the amplifier offset. R53 reduces the amplifier gain by 10 dB when the OUTPUT LEVEL switch is set to +10 dBm. This compensates for the 10 dB increase of the amplifier input. Resistor R60 limits the maximum meter current.

Varactor Bias Current Source (A3)

Transistor Q6 together with the Varactor Cathode Bias voltages (derived from the 52.1V or +20V power supplies) and the FINE TUNE control (Service Sheet 6) provides the varactor cathode bias. The base of Q6 is held one diode junction drop above ground by CR17. This fixes the emitter voltage at ground potential and sets the current through Q6. The current flows from the various source impedances of the Varactor Cathode Bias circuits (as selected by the RANGE switch) through the FINE TUNE control (Service Sheet 6) to Q6, setting the varactor cathode voltage. Variations in FINE TUNE settings change this resistive divider and consequently the varactor cathode voltage. In addition, small signals at the PHASE LOCK INPUT add to or subtract from the current through R63. Since the emitter of Q6 is held at 0 volts, the current through Q6 must change to compensate for the additional current of the phase lock input. The new current level causes different voltage drops across the resistive loads changing the varactor cathode potential. Large positive phase lock inputs are conducted through CR18 and CR17 to ground. Capacitor C29 frequency compensates the circuit to prevent phase lock loop instability.

TROUBLESHOOTING

Measuring inputs and outputs and comparing them with the normal reading as shown on the schematic is the most efficient way of isolating a malfunctioning stage.

P/O A3 ASSEMBLY

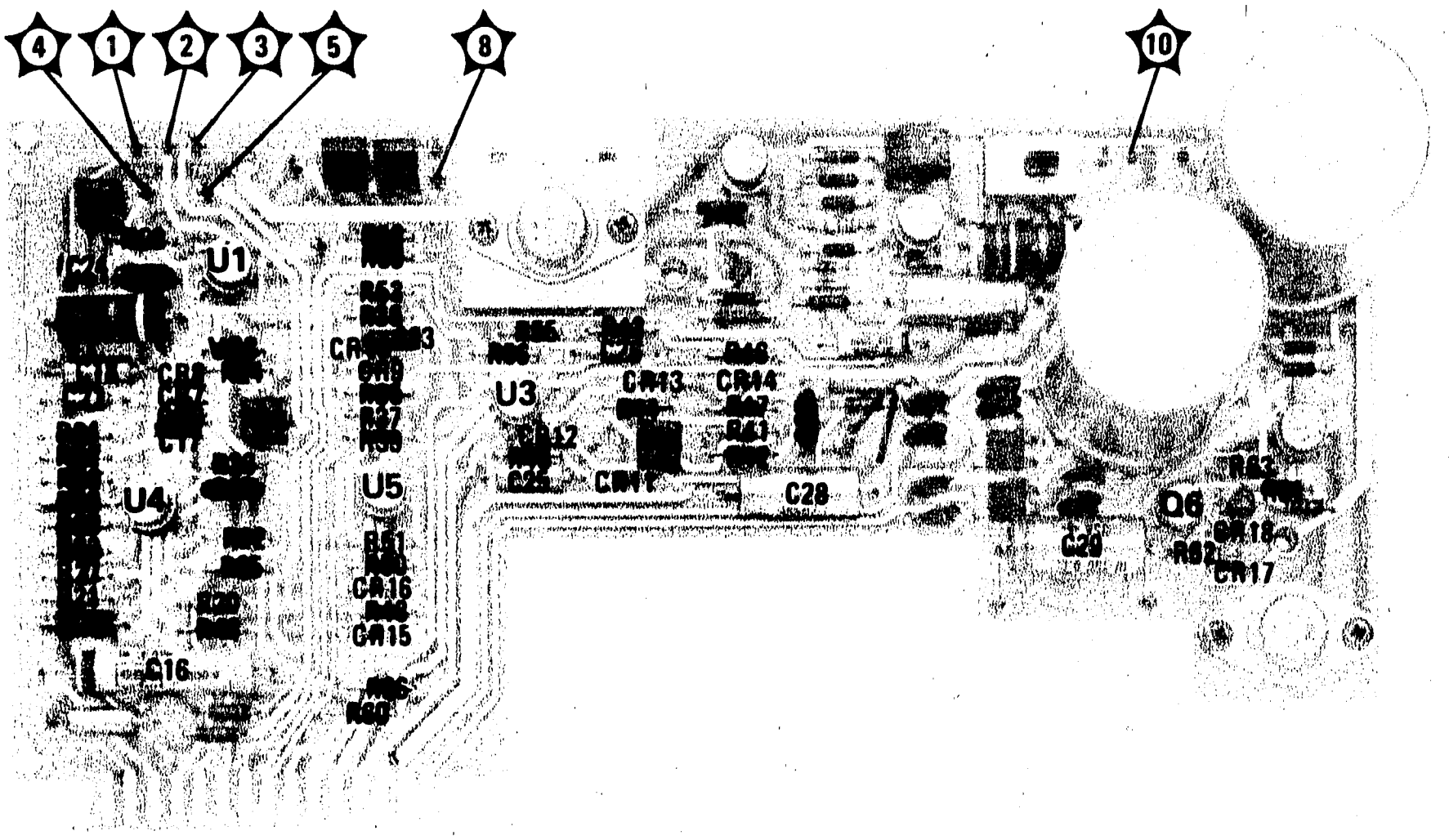
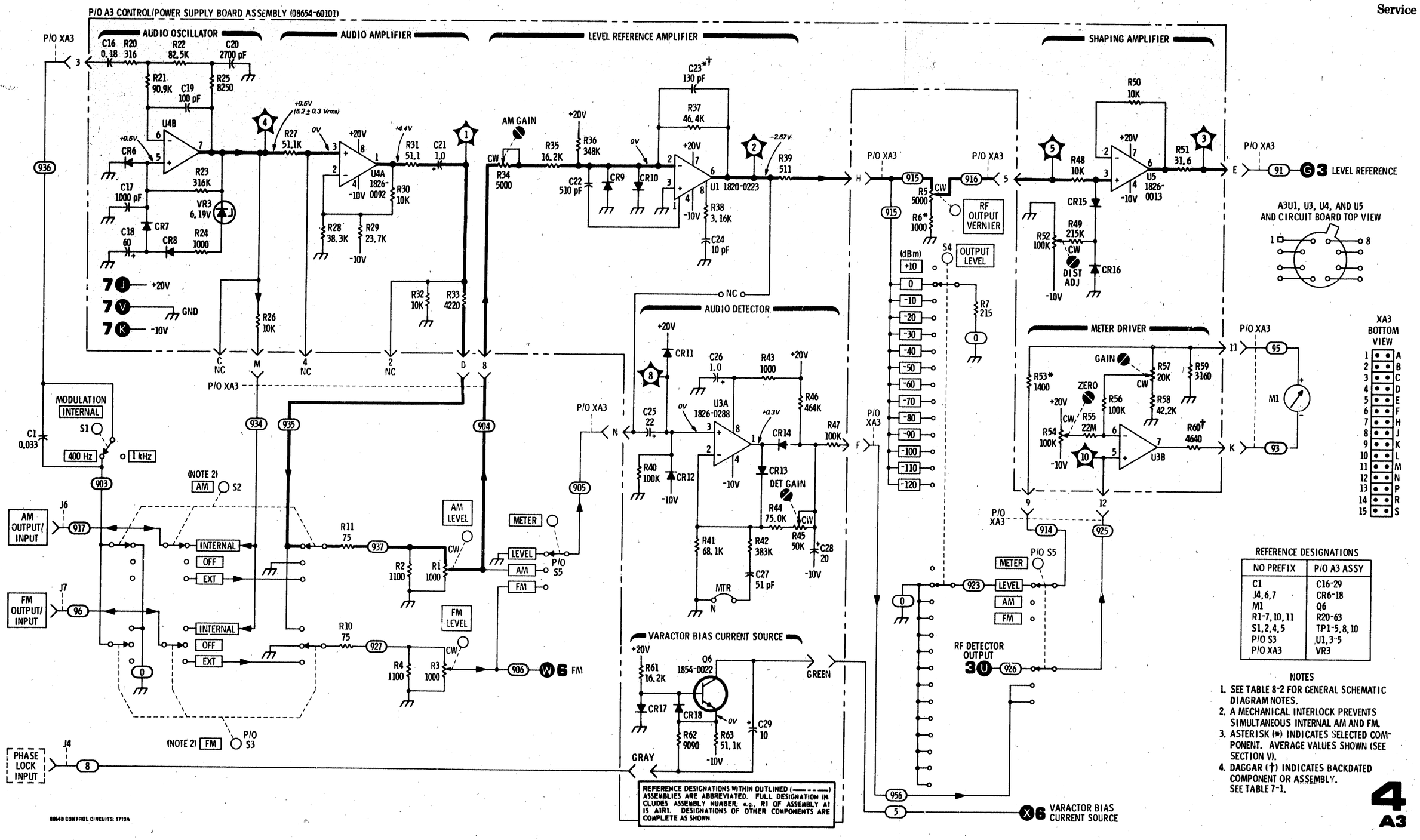


Figure 8-14. P/O A3 Control/Power Supply Board Assembly Component Locations



REFERENCE DESIGNATIONS

NO PREFIX	P/O A3 ASSY
C1	C16-29
J4,6,7	CR6-18
M1	Q6
R1-7,10,11	R20-63
S1,2,4,5	TP1-5,8,10
P/O S3	U1,3-5
P/O XA3	VR3

NOTES

1. SEE TABLE 8-2 FOR GENERAL SCHEMATIC DIAGRAM NOTES.
2. A MECHANICAL INTERLOCK PREVENTS SIMULTANEOUS INTERNAL AM AND FM.
3. ASTERISK (*) INDICATES SELECTED COMPONENT. AVERAGE VALUES SHOWN (SEE SECTION V).
4. DAGGAR (†) INDICATES BACKDATED COMPONENT OR ASSEMBLY. SEE TABLE 7-1.

4 A3

Figure 8-15. P/O A3 Assembly (Control) Schematic Diagram

SERVICE SHEET 5

FM System — General

The FM circuits of the 8654B form a non-linear analog computer that processes the FM input signal to yield calibrated, low-distortion frequency modulation of the generator's RF output. The system makes extensive use of operational amplifier circuits (linear and non-linear) to process analog voltages representing the following parameters — all of which affect FM:

1. FREQUENCY TUNE control position.
2. FREQUENCY FINE TUNE setting.
3. FREQUENCY RANGE setting.
4. FM input signal attenuated through the FM LEVEL control.
5. FM RANGE setting.
6. Varactor tuning characteristic.
7. Phase lock tune signal (if present).

The relationship between the FM input signal and the signal at the varactor anode is a non-linear function of the above parameters. This relationship may be expressed by the following formula:

$$V_a = \left[\frac{1}{k}\,\frac{(V_b - V_a)^{\frac{3}{2}}}{(V_f)^3}\right] V_{FM}$$

where: V_a is the varactor anode voltage,

V_{FM} is the FM input voltage attenuated by the FM LEVEL control,

V_b is the varactor bias voltage (at the cathode) including the fine tune setting and the phase lock signal when present,

V_f is the voltage representing the RF frequency to which generator is tuned and is a non-linear function of the position of the cursor,

and k is a constant determined by the frequency range, the FM deviation range, and the specific varactor diodes.

To process the input signal according to the above relationship, the FM circuits use logarithms and exponentials and make use of the mathematical property that $\exp(n \ln x) = x^n$. The computation actually performed by the circuitry is the following:

$$V_a = \frac{1}{k}\exp\left[\frac{3}{2}\ln(V_b - V_a) - 3\ln V_f\right] V_{FM}$$

A mathematical block diagram of the FM circuitry annotated to show how the above formula is executed appears in Figure 8-16.

FM Control - General

The circuits of Service Sheet 5 develop a voltage (V_f) corresponding to the FREQUENCY TUNE control position on a given frequency range. The shaping network adjusts this voltage for the non-linear frequency-vs-cursor-position characteristic of the tuning capacitor illustrated in Figure 5-4. This network also compensates for the stray capacitances in the RF oscillator circuits and the stray inductance within the tuning capacitor which are significant on the higher frequency ranges.

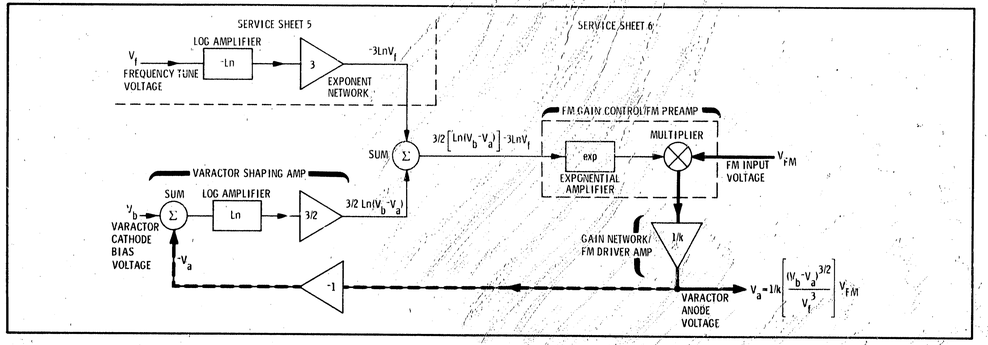


Figure 8-16. Mathematical Block Diagram of the FM Driver Assembly

SERVICE SHEET 5 (Cont'd)

DC Shaping Circuit (A5)

A1R2 is mechanically coupled to tuning capacitor A1C3 (Service Sheet 2). U1A and U1B are voltage followers that buffer the two reference voltages set by divider string R15 through R19. The voltage difference between the outputs of U1 is imposed across A1R2 and also across the break-point resistors R1 through R14. Tuning FREQUENCY TUNE down from the top of a given range causes the voltage at TP3 to fall linearly until it is lower than the voltage at the break-point divider for that range. When this occurs, CR6 turns on, and the voltage at the (+) input of U5 becomes the breakpoint voltage minus the voltage at TP3, divided across the corresponding slope resistor (R22 through R30) and R31. In order to track frequency on the three highest ranges, two breakpoints (and slopes) are required. Diodes CR3, CR4, and CR5 switch in the second break-points and slope resistors on these ranges. Voltage follower U5 isolates this voltage and drives log amplifier U6.

Log Amplifier (A5)

Amplifier U6 is connected as an inverting logarithmic amplifier. The logarithmic function is generated by the diode, CR1F, in the feedback path. Since the amplifier feedback holds the anode of CR1F to ground, the output of the amplifier is equal to the voltage drop across CR1F. If the current through the diode is kept low, the voltage across the diode is a logarithmic function of forward current. Thus, a linear input current through R36 yields a logarithmic output voltage across CR1F. Input resistor R36 determines the gain factor of the amplifier and is large enough to keep the current through CR1F low. C2 and C4 bypass RFI, and C3 frequency compensates the amplifier. Diode CR9 prevents CR1F from becoming reverse biased.

SERVICE SHEET 5 (Cont'd)

U7 is a non-inverting amplifier which provides additional gain to the log amplifier stage. Diode CR1D is forward biased by the current path through R49, R41, and R42, and it thermally tracks CR1F to compensate for the effects of temperature changes on the output of U6. R42 allows the offset of U7 to be adjusted to compensate for different diodes. R46, R47, and the exponent network form a voltage divider in the feeback loop of U7 that sets the gain. This gain adjustment is necessary because the stray reactances in the RF oscillator circuit cause the percent of tuning capacitor rotation required to span a given percent of a frequency range to be different for each range. Capacitors C5 and C8 bypass RFI, and C7 rolls off the amplifier's ac gain to reduce system noise.

TROUBLESHOOTING

The circuits on this part of the A5 FM Driver Board Assembly are dc shaping circuits only. Troubleshoot the circuit by checking the dc voltages at the test points given in the table for various frequency settings. Also, use an oscilloscope to check the outputs of the amplifiers for spurious oscillations.

TEST EQUIPMENT

Digital Multimeter..... HP 34702A/34740A
Oscilloscope .....HP 182C/1801A/1820C

INITIAL CONTROL SETTINGS

FREQUENCY FINE TUNE .....Fully ccw
AM .....OFF
FM .....OFF
FM RANGE (kHz) .....30 kHz
FM LEVEL.....Fully ccw

FM DRIVER Assembly Troubleshooting (Service Sheet 5)

FREQUENCY RANGE (MHz)	FREQUENCY TUNE (MHz)	A5TP3 (Vdc)		A5TPA (Vdc)		A5TPB (Vdc)		A5TP5 (Vdc)	
		Min	Max	Min	Max	Min	Max	Min	Max
10–19	10	5.2	5.6	5.4	5.8	–0.69	–0.61	1.9	2.3
19–35	Do not change setting	5.2	5.6	5.4	5.8	–0.69	–0.61	1.9	2.3
35–66	"	5.2	5.6	5.4	5.8	–0.69	–0.61	1.9	2.3
66–130	"	5.2	5.6	5.4	5.8	–0.69	–0.61	2.0	2.4
130–270	"	5.2	5.6	5.5	5.9	–0.69	–0.61	2.1	2.5
270–520	"	5.2	5.6	5.8	6.2	–0.69	–0.61	2.5	3.1
10–19	18	9.5	9.9	9.5	9.9	–0.70	–0.62	–1.4	–1.0
19–35	Do not change setting	9.5	9.9	9.5	9.9	–0.70	–0.62	–1.4	–1.0
35–66	"	9.5	9.9	9.5	9.9	–0.70	–0.62	–1.4	–1.0
66–130	"	9.5	9.9	9.5	9.9	–0.70	–0.62	–1.6	–1.2
130–270	"	9.5	9.9	9.5	9.9	–0.70	–0.62	–2.0	–1.6
270–520	"	9.5	9.9	9.5	9.9	–0.70	–0.62	–4.0	–3.2

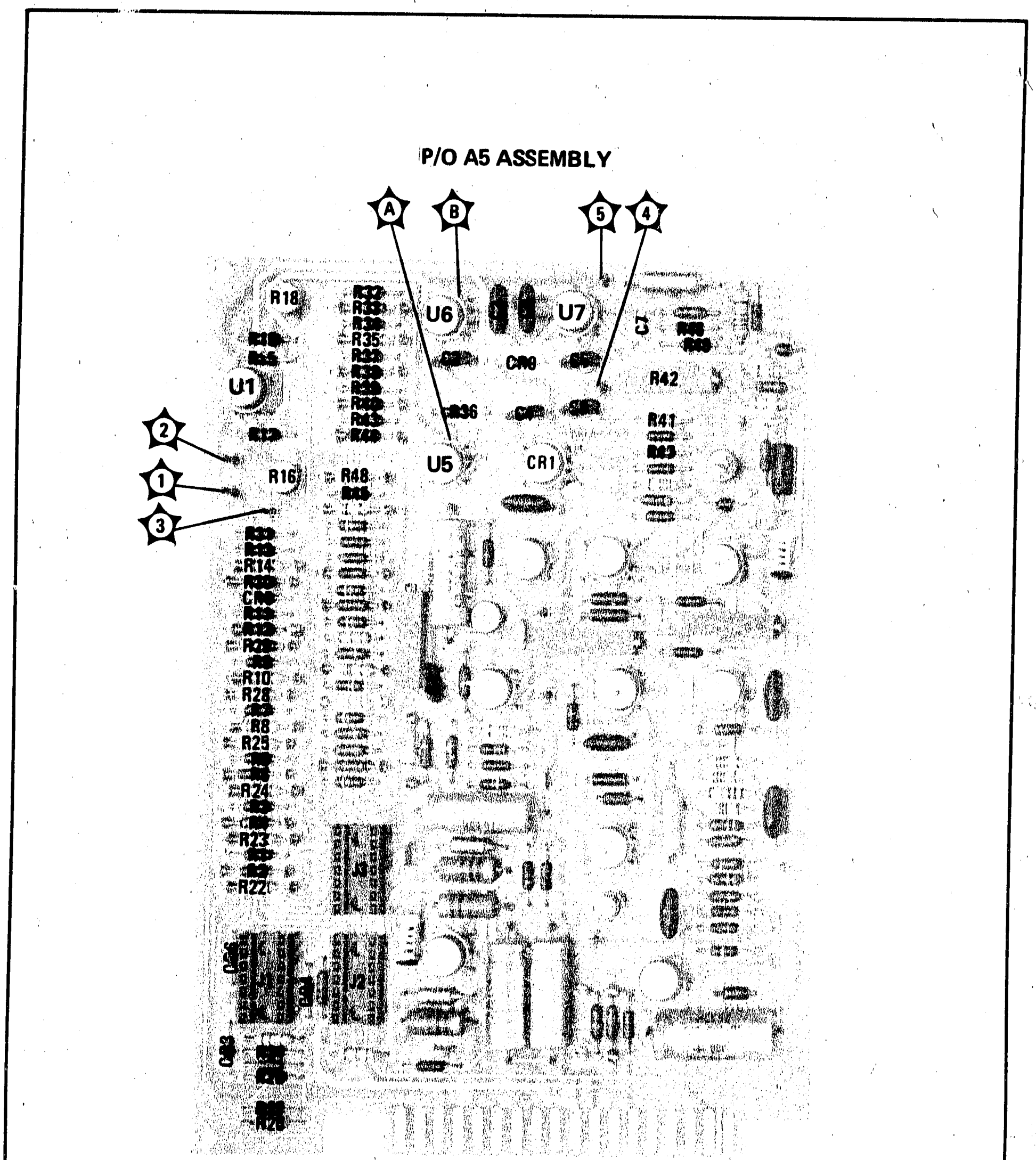
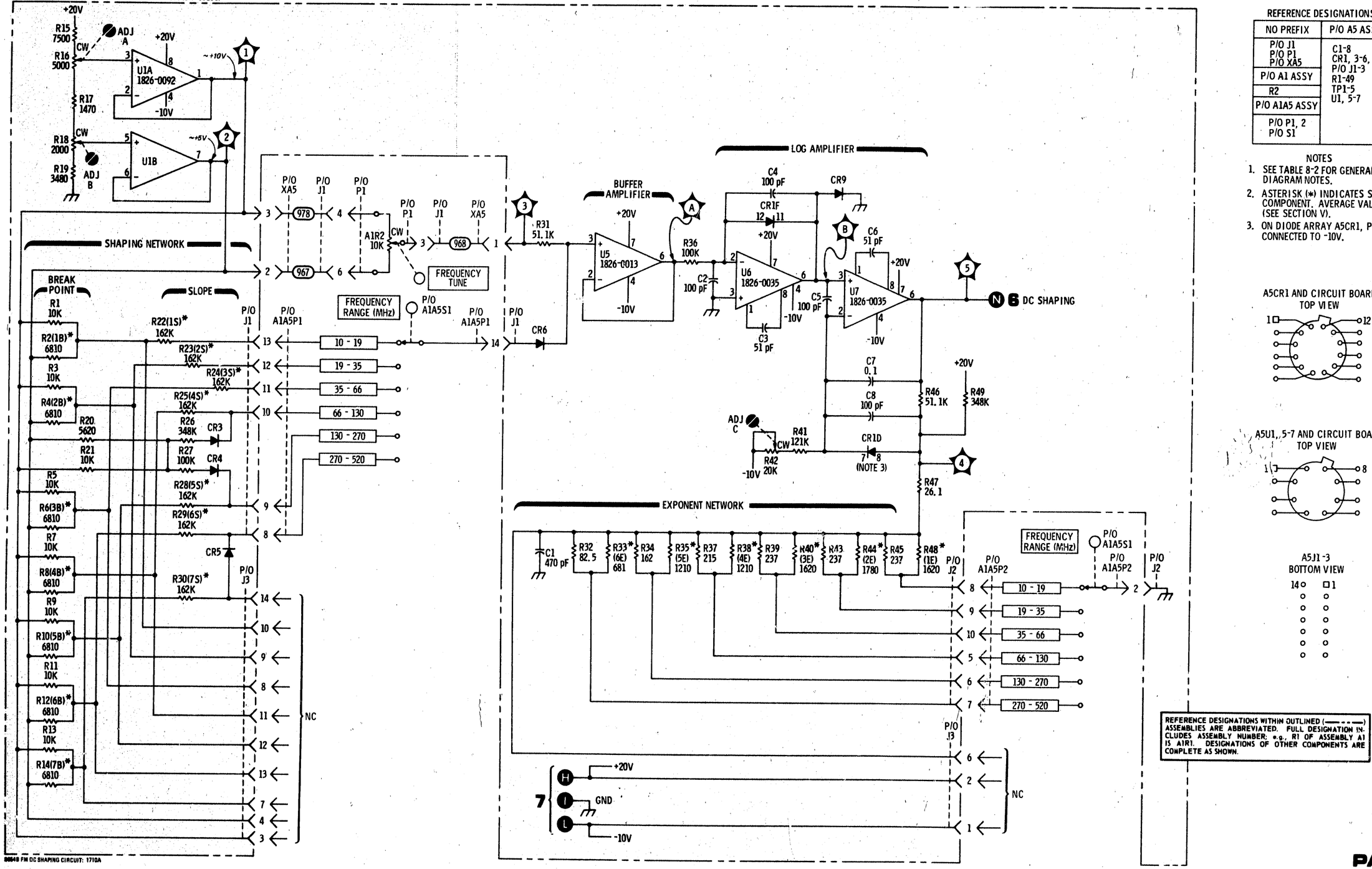


Figure 8-17. P/O A5 FM Driver Board Assembly Component Locations

P/O A5 FM DRIVER BOARD ASSEMBLY (08654-60106)



REFERENCE DESIGNATIONS

NO PREFIX	P/O A5 ASSY
P/O J1 P/O P1 P/O XA5	C1-8 CR1, 3-6, 9 P/O J1-3
P/O A1 ASSY	R1-49
R2	TP1-5
P/O A1A5 ASSY	U1, 5-7
P/O P1, 2 P/O S1	

NOTES

1. SEE TABLE 8-2 FOR GENERAL SCHEMATIC DIAGRAM NOTES.
2. ASTERISK (*) INDICATES SELECTED COMPONENT. AVERAGE VALUES SHOWN (SEE SECTION V).
3. ON DIODE ARRAY A5CR1, PIN 10 CONNECTED TO -10V.

8654B FM DC SHAPING CIRCUIT: 1710A

5 P/O A5

Figure 8-18. P/O A5 Assembly (FM Control) Schematic Diagram

SERVICE SHEET 6

FM DRIVER

General

The circuits on Service Sheet 6 sum the feedback generated by the Varactor Shaping Amplifier with the frequency tune output voltage of the DC Shaping Circuit of Service Sheet 5. The summed voltage controls the gain of the FM Preamplifier which amplifies the FM input signal. The signal is further amplified by the FM Driver Amplifier whose gain is determined by the frequency range and the FM deviation range selected. The output drives the varactor anode.

FM Gain Control and FM Preamplifier (A5)

The input to U4 from U7 of the DC Shaping Circuit (Service Sheet 5) is a dc voltage proportional to the RF tuning frequency. This voltage is divided by R50 and R53 and summed with the feedback voltage from the Varactor Shaping Amplifier, U11. U4, a voltage follower, buffers the summed signal and drives diodes CR2A and CR2B. The voltage output of U9 exactly complements the voltage output of U4 forming a net zero voltage potential at the node between the diodes. Resistive divider R62 through R64 is in parallel with the two diodes. Adjustment E (R63) sets the node between the two diodes to zero potential. CR2C prevents reverse biasing of CR2A and CR2B when the instrument is turned on. The impedance at this node is an exponential function of the voltage across the diodes. Because the diodes are in the feedback loop of U3, they determine its *gain*. Thus, a linear change in voltage at the input of U4 will cause an exponential change in the *gain* of U3. The FM Preamplifier U3 amplifies the modulation signal from the FM LEVEL potentiometer. The output of U3 is therefore equal to the FM modulation signal multiplied by the exponential of the input to U4. CR2D provides thermal compensation for CR2A and CR2B. C9 speeds up the ac response of diode CR2D. The resistor network composed of R56, R57, R58, R60, and thermistor RT1 compensates for changes in varactor tuning sensitivity with temperature.

The gain of U3 is determined by R59, R55, and the non-linear impedance at the node between CR2A and CR2B. Since U3 is a

SERVICE SHEET 6 (Cont'd)

non-inverting amplifier, when the ratio of feedback resistance to diode impedance approaches unity, the amplifier's gain strays slightly from a pure ratio of impedances. R54 introduces a small portion of the modulation signal into the amplifier's inverting input causing the gain of U3 to follow the impedance ratio more closely. R122 adjusts the dc offset of U3, and R59 is the master gain adjustment for the FM circuits.

FM Driver Amplifier (A5)

The output of U3 couples through the Gain Network to the FM Driver Amplifier U2. U2 is an inverting amplifier whose gain is set for each frequency range by changing the feedback resistance R77 through R82. For the 100 kHz FM deviation range, the feedback is further attenuated through divider R84 through R85. R65 through R76 fine adjust the resistance at the input to U2. The gain of U2 for peak deviations of 3, 10, and 30 kHz is set by the Gain Network and output dividers R87 through R91. On the 100 kHz deviation range, the gain of U2 is increased by adding the divider formed by R84, R85, and R86 into the feedback loop of the amplifier. L3 and C14 peak the amplifier's frequency response. C19 and C20 filter the noise on the line to the varactor anode when FM is off.

Varactor Shaping Amplifier (A5)

The Varactor Shaping Amplifier circuits provide feedback compensation to the FM Gain Control stage in order to linearize the voltage-vs-tuning response curve of the varactor diodes. Since the diode response depends on the dc bias as well as the ac modulation signal, both components enter into the shaping.

Amplifier U8A is a voltage follower which buffers a portion of the dc bias at the varactor cathodes. R97 and R98 divide the bias voltage. To optimize the Q and voltage swing of the varactors, switch A1A5S1 applies higher bias voltages to the varactor cathodes on higher frequency ranges. The FINE TUNE control varies this bias to fine adjust the oscillator output frequency. R97 and R98 apply a portion of this bias voltage to buffer amplifier U8A. C22 assures that only dc signals reach the amplifier.

SERVICE SHEET 6 (Cont'd)

Just as U8 buffers a voltage representing the varactor cathode dc bias, U10A buffers (and inverts) a voltage representing the ac and dc varactor anode signal. R93, R94, and C21 form a frequency sensitive divider at the input of U10A. R95 and R99 set U10A gain to unity. The output is coupled through R100 and C23 to the summing junction at the non-inverting input of U10B. The current flowing into this junction is proportional to the total voltage across the varactors.

Amplifier U10B is connected as an inverting logarithmic amplifier. The logarithmic function is generated by the diode, CR1B, in the Feedback path. Since the amplifier's feedback forces the voltage at the anode of CR1B to ground, the output voltage of the amplifier is equal to the voltage drop across CR1B. If the current through the diode is kept low, voltage across diode is a logarithmic function of input current to the amplifier. Thus, a linear input current yields a logarithmic output voltage across CR1B. CR1A prevents reverse voltage across CR1B.

U11 amplifies the varactor shaping voltage. The gain of this stage is set by feedback resistors R107 and R108, and input resistances R103, R106, and RT2. CR1C temperature compensates CR1B of the log amplifier U10B. R104, R105, and R102 provide an adjustable offset bias current into CR1C. Additional temperature compensation is provided by RT2 at the input of U11. Since the output of this circuit acts as feedback into the summing junction of the FM Gain Control amplifiers, the gain adjust R107 controls the dynamic shaping response of the entire FM circuitry to compensate for the varactor nonlinearities — minimizing FM distortion.

TROUBLESHOOTING

The circuits on this part of the A5 FM Driver Board Assembly are non-linear ac and dc shaping circuits. The output of the circuit is at A5TP8 which drives the varactor diodes on the A1A2 FM Modulator Board Assembly. To troubleshoot the circuit, first verify that the voltage is correct at A5TP5 (see Troubleshooting on Service Sheet 5), then check the ac and dc voltages given in the

SERVICE SHEET 6 (Cont'd)

procedure below. Check the voltages in the order listed. If only one frequency range is defective, check only that range. If FM deviation is only slightly in error, performing the FM adjustments may correct for this. Also use an oscilloscope to check the outputs of the operational amplifiers for spurious oscillation.

NOTE

Distortion in the ac waveforms is normal at A5TPG and A5TP10 especially where the relative input voltage at A5TP9 is large. The waveform, however, should be smooth with no clipping.

TEST EQUIPMENT:

Digital Multimeter ..... HP 34702A/34740A
Oscilloscope ..... HP 182C/1801A/1820C
Test Oscillator ..... HP 651B

SERVICE SHEET 6 (Cont'd)

PROCEDURE:

1. Unsolder jumper wire between test points A5TP8 and TP9.
2. Set Signal Generator controls as follows:
   FREQUENCY RANGE . . . 10–19 MHz
   FREQUENCY TUNE . . . . 10 MHz
   FINE TUNE. . . . . Fully cw
   AM . . . . . OFF
   FM . . . . . INTERNAL
   FM RANGE (kHz) . . . . . 30 kHz
   FM LEVEL . . . . . Fully cw
   400 Hz/1 kHz . . . . . 1 kHz
3. Connect voltmeter to A5TP7 and adjust FM LEVEL for 600 mVrms.
4. Set FREQUENCY RANGE, FREQUENCY TUNE, and FM as listed in the table below and check ac and dc voltages at the test points indicated.

FM Driver Board Assembly Troubleshooting (Part I)

FREQUENCY RANGE (MHz)	FREQUENCY TUNE (MHz)	A5TP6 with FM OFF (mVdc)		A5TP6 with FM INTERNAL (mVrms)		A5TPC with FM OFF (mVdc)		A5TPC with FM INTERNAL (mVrms)		A5TP8 with FM OFF (mVdc)		A5TP8 with FM INTERNAL (mVrms)	
		Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max
10–19	10	–0.5	+0.5	5.0	5.8	–20	+20	105	135	–500	+500	2800	3400
19–35	Do not change setting	–0.5	+0.5	5.0	5.8	–20	+20	105	135	–300	+300	1600	2000
35–66	"	–0.5	+0.5	5.0	5.8	–20	+20	170	230	–300	+300	3100	3800
66–130	"	–0.5	+0.5	5.0	5.8	–20	+20	180	240	–150	+150	1500	1900
130–270	"	–0.5	+0.5	5.0	5.8	–20	+20	200	260	– 75	+ 75	900	1100
270–520	"	–0.5	+0.5	5.0	5.8	–20	+20	330	450	–100	+100	1600	2100
10–19	19	–0.5	+0.5	5.0	5.8	–20	+20	18	25	–500	+500	500	600
19–35	Do not change setting	–0.5	+0.5	5.0	5.8	–20	+20	18	25	–300	+300	250	350
35–66	"	–0.5	+0.5	5.0	5.8	–20	+20	28	38	–300	+300	500	650
66–130	"	–0.5	+0.5	5.0	5.8	–20	+20	25	35	–150	+150	220	270
130–270	"	–0.5	+0.5	5.0	5.8	–20	+20	20	28	– 75	+ 75	90	160
270–520	"	–0.5	+0.5	5.0	5.8	–20	+20	10	15	–100	+100	40	120

SERVICE SHEET 6 (Cont'd)

5. Set FM to OFF. Connect test oscillator to A5TP9. Set frequency to 1 kHz and adjust level for 3 Vrms at A5TP9.
6. Set FREQUENCY RANGE as listed in the table below and check ac and dc voltages at test points listed.

NOTE

Disconnect test oscillator from A5TP9 when measuring dc voltages.

FM Driver Board Assembly Troubleshooting (Part II)

FREQUENCY RANGE (MHz)	A5TPD (Vdc)		A5TPE (Vdc)		A5TPF (Vdc)		A5TPF (mVrms)		A5TPG (mVdc)	
	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max
10–35	+10.3	+10.7	+2.20	+2.50	–1.40	–1.20	290	360	–650	–590
35–270	+28.2	+30.6	+6.2	+7.00	–3.80	–3.30	290	360	–680	–610
270–520	+47.0	+50.0	+10.3	+11.4	–6.20	–5.50	290	360	–690	–620

FREQUENCY RANGE (MHz)	A5TPG (mVrms)		A5TP10 (mVdc)		A5TP10 (mVrms)	
	Min	Max	Min	Max	Min	Max
10–35	10	12	–10	+10	14	18
35–270	3.4	4.2	+35	+55	6	8
270–520	2.2	2.7	+55	+80	4	6

7. Resolder jumper between A5TP8 and TP9.

P/O A5 ASSEMBLY

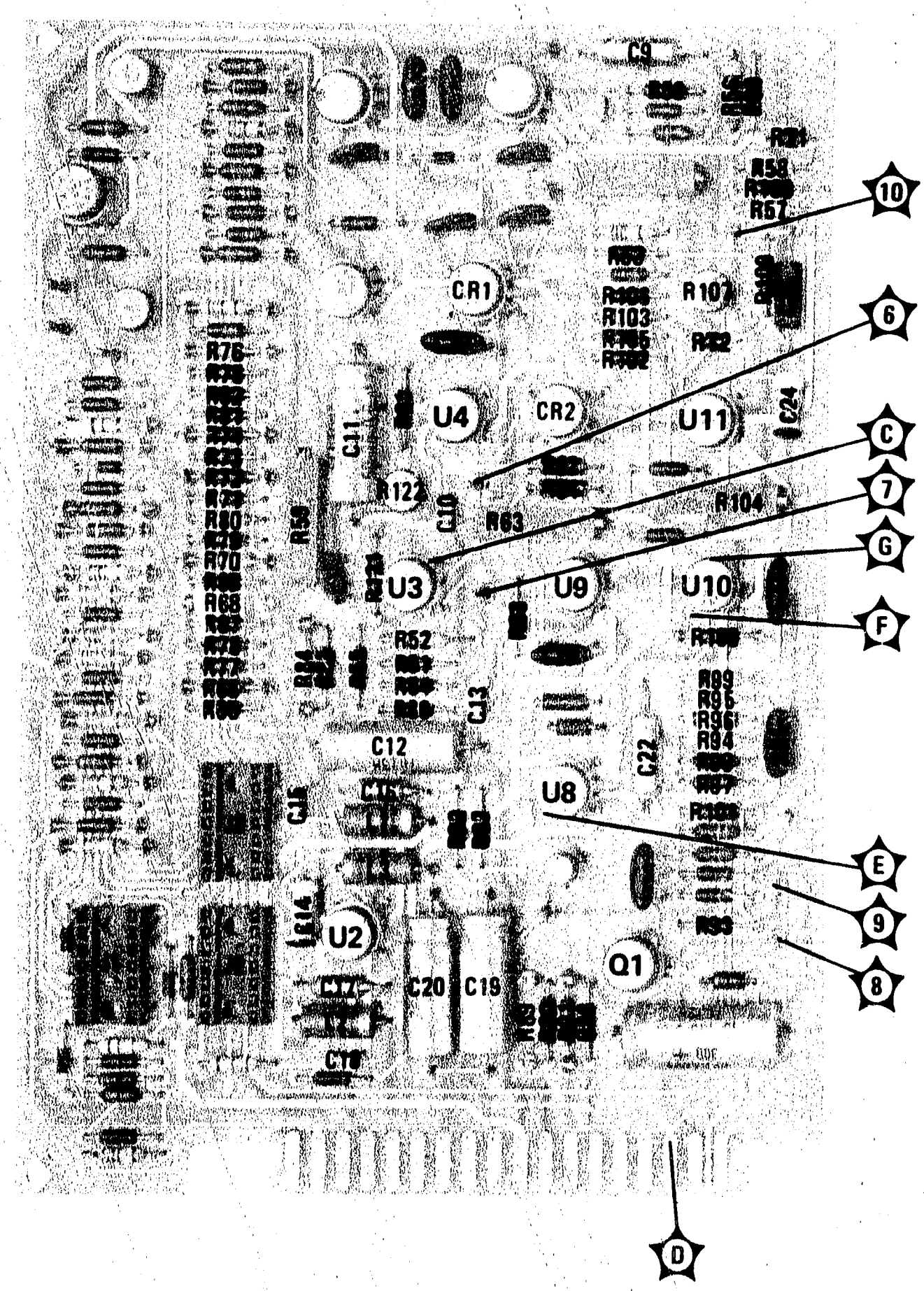
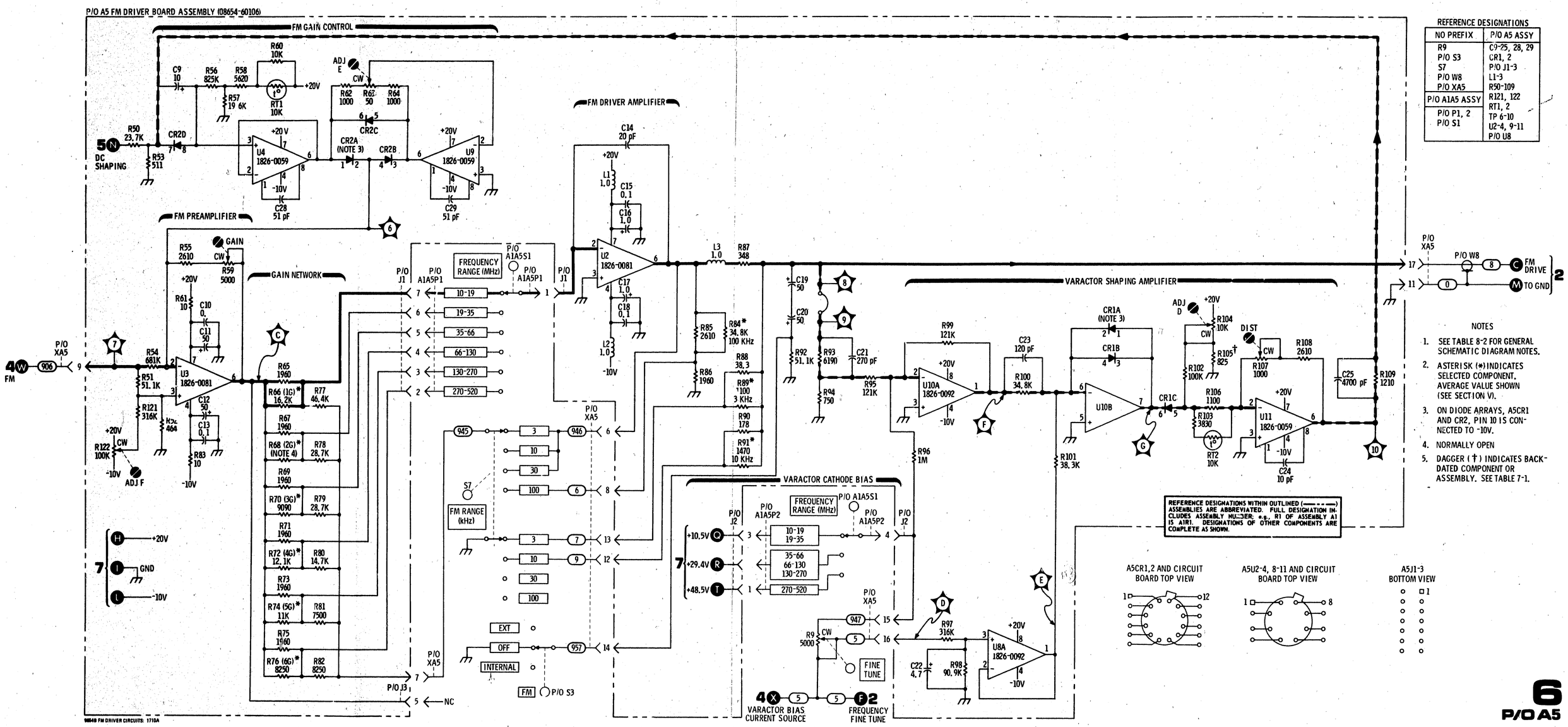


Figure 8-19. P/O A5 FM Driver Board Assembly Component Locations



REFERENCE DESIGNATIONS	
NO PREFIX	P/O A5 ASSY
R9	C9-25, 28, 29
P/O S3	CR1, 2
S7	P/O J1-3
P/O W8	L1-3
P/O XA5	R50-109
P/O A1A5 ASSY	R121, 122
	RT1, 2
P/O P1, 2	TP 6-10
P/O S1	U2-4, 9-11
	P/O U8

NOTES

1. SEE TABLE 8-2 FOR GENERAL SCHEMATIC DIAGRAM NOTES.
2. ASTERISK (*) INDICATES SELECTED COMPONENT. AVERAGE VALUE SHOWN (SEE SECTION V).
3. ON DIODE ARRAYS, A5CR1 AND CR2, PIN 10 IS CONNECTED TO -10V.
4. NORMALLY OPEN
5. DAGGER (†) INDICATES BACK-DATED COMPONENT OR ASSEMBLY. SEE TABLE 7-1.

Figure 8-20. P/O A5 Assembly (FM Driver) Schematic Diagram

SERVICE SHEET 7

PRINCIPLES OF OPERATION

+20 Volt Regulator (A3)

The +20 Volt Regulator is a linear series type with current limiting for over-current protection. The series regulator transistor Q1 is collector (case) grounded and regulates on the ground return side of the supply. Amplifier U2 compares the output voltage with the reference established by VR1; the output drives transistor Q2. Q2 is a common-base amplifier which drives Q1. RC networks R10 and C13, R19, and C15, and R15 and C14 provide frequency compensation. Transistor Q3 senses excessive supply current flowing through R16 and shuts down the supply by taking drive current away from the base of Q1. Resistor R14 biases the base of Q2 during turn on and diodes CR4 and CR5 clamp the base near ground potential when the supply is on.

The Power Supply Isolation Switch S1 aids in fault isolation of the +20V supply. By switching S1 to TEST, the +20V supply is conected to a test load R8, also the sense line (going to VR1 and R4) is connected directly on the Power Supply Assembly (rather than in A1). If a short had existed on A3 or elsewhere in the instrument, the supply would now operate normally and thus verify that the supply was not at fault.

−10 Volt Regulator (A3)

The −10 Volt Regulator is a linear series type with current limiting. The supply is dependent on the +20 Vdc supply for its operation. Amplifier U6 compares ground with the output of voltage divider R2 and R3, which is connected between the +20 Vdc and −10 Vdc outputs. U6 drives the series regulator transistor Q5. RC network R7 and C12 provide frequency compensation. Transistor Q4 limits suppply current.

+52.1 Volt Regulator (A5)

The +52.1V Regulator is a linear series type with current limiting. The supply is dependent on the +20 Vdc supply for its operation. Amplifier U8B compares a +10V reference (derived from the +20V supply through resistive divider R110 and R111) with the output of voltage divider R116 and R117. The current through R112 provides the base current series regulator Q1. By sinking some of the current through R112, U8B adjusts the drive to Q1, regulating the output voltage. VR1 drops the high voltage required at the base of Q1 to a level compatible with U8B. Transistor Q2 limits the supply current. Capacitor C27 provides frequency compensation.

TROUBLESHOOTING

Before attempting to troubleshoot the power supplies, check the lamp in the LINE switch to see if it is illuminated. If not, check the fuse. Also verify that the transformer primary is matched to the available line voltage (refer to Figure 2-1).

SERVICE SHEET 7 (Cont'd)

The −10 volt supply is dependent on the +20 volt supply. Check the +20 volt supply before attempting to troubleshoot the −10 volt supply.

Q3 and Q4 are current limiting transistors. If the voltage measured across R16 or R9 is ≈0.6 Vdc, the supply which exhibits this condition will have a voltage lower than normal due to excess current flow.

Total current flow through a power supply may be calculated by measuring the voltage across R16 or R9. The total current flow to the A1 RF Section Assembly may be measured at XA3 pin 6 (+20 volt supply) and XA3 pin 10 (−10 volt supply). Malfunctioning components which cause high current flow may be isolated to the RF assembly or chassis by measuring the total and RF section current flow. One may also measure resistance at the power supply output with the instrument turned off.

Measurement	Supply	
	+20V	−10V
Total Current	0.30A	0.16A
RF Assy Current	0.14A	0.05A
Resistance	1.5kΩ *	950Ω**

* S1 switch set to TEST.
**S1 switch set to NORMAL.

If noise is evident in the power supplies in the form of ripple, a filter capacitor may be defective. The ripple frequency is normally 120 Hz; if it is 60 Hz, a rectifier diode quad is probably defective. White noise may be caused by a defective operational amplifier (U2 or U6) or the regulator diode VR1. RF noise would be evident if the high-frequency rolloff networks (R15 and C14, R10 and C13, C15 and R19; R7 and C12) are defective.

FM Driver Assembly (P/O A5)
SERVICE SHEET 6

P/O A3 ASSEMBLY

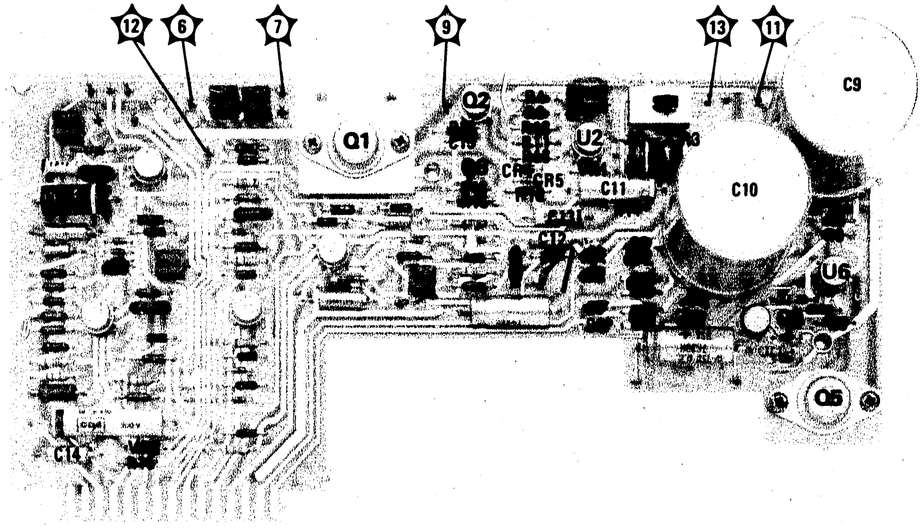


Figure 8-21. P/O A3 Control/Power Supply Board Assembly Component Locations

P/O A5 ASSEMBLY

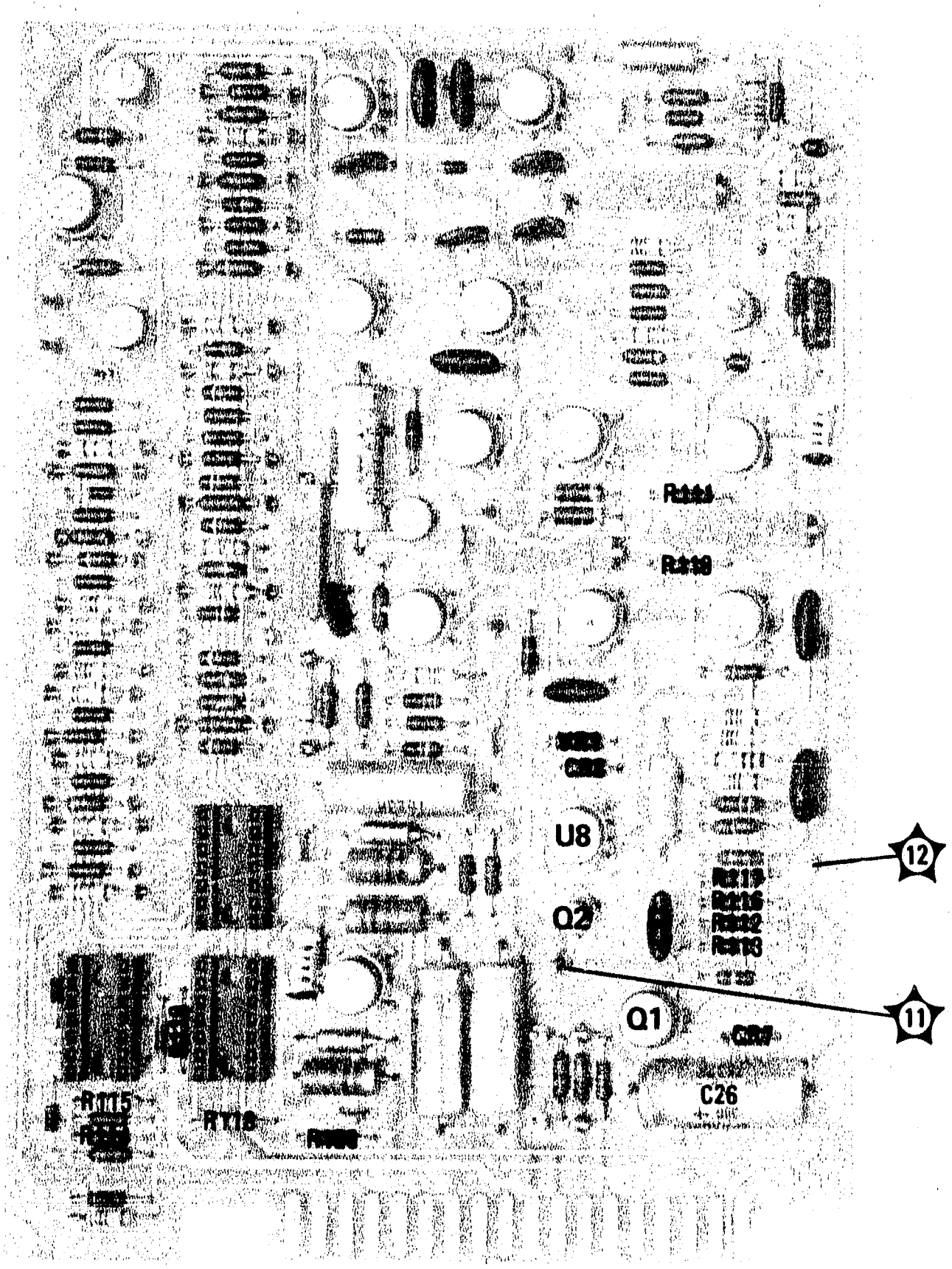
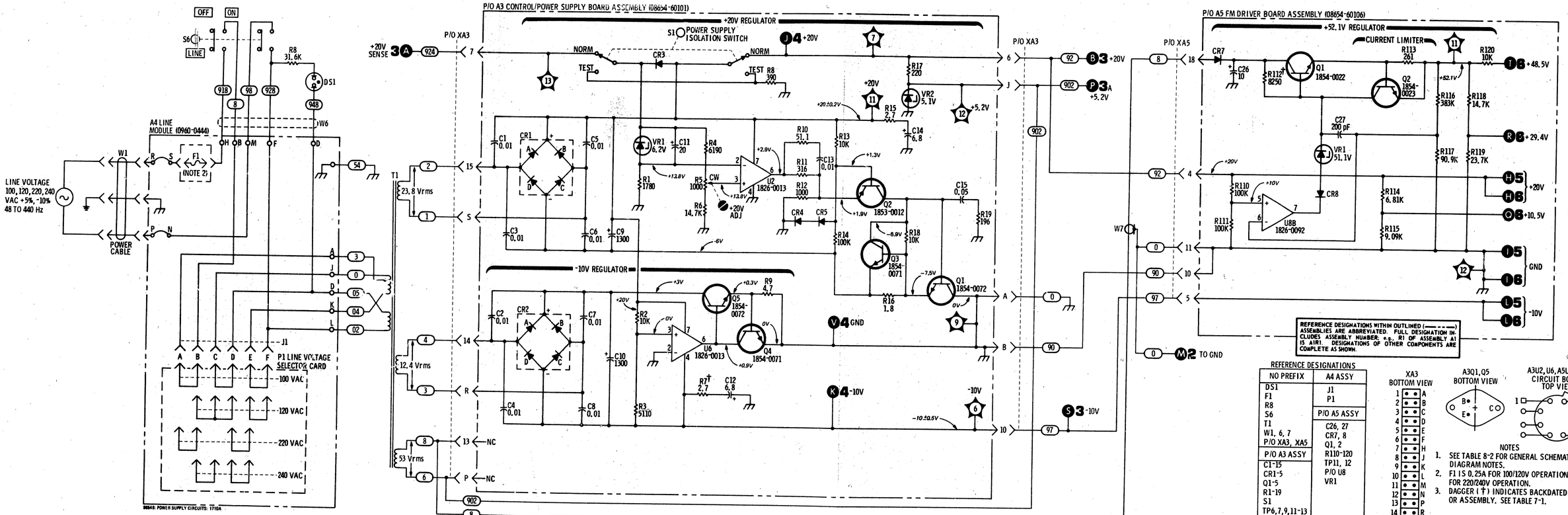


Figure 8-22. P/O A5 FM Driver Board Assembly Component Locations



REFERENCE DESIGNATIONS	
NO PREFIX	A4 ASSY
DS1	J1
F1	P1
R8	
S6	P/O A5 ASSY
T1	
W1, 6, 7	C26, 27
P/O XA3, XA5	CR7, 8
	Q1, 2
P/O A3 ASSY	R110-120
C1-15	TP11, 12
CR1-5	P/O U8
Q1-5	VR1
R1-19	
S1	
TP6,7,9,11-13	
U2, 6	
VR1, 2	

XA3 BOTTOM VIEW

A3Q1, Q5 BOTTOM VIEW

A3U2, U6, A5U8 AND CIRCUIT BOARD TOP VIEW

NOTES
1. SEE TABLE 8-2 FOR GENERAL SCHEMATIC DIAGRAM NOTES.
2. F1 IS 0.25A FOR 100/120V OPERATION, OR 0.175A FOR 220/240V OPERATION.
3. DAGGER (†) INDICATES BACKDATED COMPONENT OR ASSEMBLY. SEE TABLE 7-1.

7
A3, A4, A5

Figure 8-23. Power Supplies Schematic Diagram

SERVICE SHEET A

A1 RF Section Disassembly and Reassembly

NOTE

Numbers in parentheses refer to Figure 8-24.

RF Section Cover (1) Removal

1. Remove RF Section Assembly (Service Sheet B).
2. Remove four pan-head screws with lockwashers (159, 161) and remove cover.

RF Section Cover (1) Installation

MICROPHONICS

In order to minimize the possibility of microphonics and RFI in the generator, perform steps 1 through 4 before replacing the RF Section cover.

1. Glue any loose wires on turret inductors with coil varnish.[1]
2. Check the Frequency Tune capacitor shaft for looseness by applying lateral pressure to the large pulley (22). If the shaft is loose, it can be tightened using the screw and locknut on the end of the capacitor opposite the pulley.
3. Check that all nuts, screws, and connectors are tight.
4. Check that the RFI braid (158) is in place and properly meshed to the RF Section cover (1).
5. Carefully lift cover into place and securely replace four pan-head screws with lockwashers (159, 161). Avoid damaging electrical or mechanical parts with cover while installing.

RF Amplifier/ALC Board Assembly Removal (A1A1)

1. Remove RF Section Assembly (Service Sheet B) and RF Section cover (procedure given above).

WARNING

The edges of the RFI gasket on the amplifier cover (132) are sharp and can cause personal injury if not handled with care.

2. Remove four pan-head screws with starwashers (130) and three pan-head screws with lockwashers (127, 128) from RF Amplifier cover (132) and lift off cover.
3. Remove W1, W2, and W4 from A1A1J1 through J3 (124, 131, 136).
4. Remove three hex nuts and lockwashers (96, 98, 101, 106, 140, 142) that secure A1A1J1 through J3 (124, 131, 136).

[1] E.g., 1202 Glyptal Clear Air Drying and Baking Varnish, General Electric Supply Co., Insulating Material Products Dept. No. 1, Campbell Rd., Schenectady, N.Y., 12306 (HP 6010-0034).

SERVICE SHEET A (Cont'd)

5. Remove 9/16-inch output amplifier bushing (139).
6. Remove two flat-head screws (126) that secure RF Amplifier divider and remove divider (133).
7. Carefully lift A1A1 RF Amplifier up and back to free board from RF Amplifier Shield. Wires attached to the board are long enough to allow board removal without unsoldering.

NOTES

The shield and ground clip near Q2 may easily be broken off. If so they must be resoldered before assembly installation to ensure proper operation of the RF Amplifier/ALC circuits.

If the assembly is to be checked for malfunctions with the board assembly removed from the casting, a ground wire must be attached from circuit board ground to chassis ground.

RF Amplifier/ALC Board Installation (A1A1)

1. Replace RF Amplifier/ALC Board while feeding the four wires through the hole for them in the RF Amplifier Shield. (Do not pinch wires beneath board.)
2. Loosely replace center divider (133) with two flat-head screws (126).
3. Replace 9/16-inch output amplifier bushing (139) and secure tightly.
4. Replace and tighten lockwashers (98, 106) and hex nuts (96, 101) that secure A1A1J2 (124) and A1A1J3 (131).
5. Replace and tighten hex nut and lockwasher (140, 142) that secures A1A1J1 (136).
6. Tighten two flat-head screws (126) that secure RF Amplifier center divider (133).
7. Replace RF Amplifier cover (132) by loosely inserting three pan-head screws with lockwashers (127, 128) and four pan-head screws with starwashers (130).

NOTE

RFI gasket should mesh neatly against the base plate (109).

8. While pressing down and forward on cover, first tighten three center screws, then four corner screws.
9. Reconnect W1 (5) to A1A1J1 (136).

RF Oscillator Board Assembly Removal (A1A3)

1. Remove RF Section Assembly (Service Sheet B) and RF Section cover (procedure given above).

SERVICE SHEET A (Cont'd)

2. Remove W1 (5) from A1A3J1 (8).
3. Remove two hex nuts (4) with lockwashers (6).
4. Unsolder two wires.

CAUTION

Be careful not to damage the capacitors close to the hex nuts. It may be necessary to grind down the sides of the hex-nut driver to gain necessary clearance from the capacitors.

RF Oscillator Board Assembly Installation (A1A3)

1. Install the RF Oscillator Board Assembly (10) by reversing the removal procedure, while observing the following considerations.

CAUTION

Do not overtighten the hex nuts. The mounting studs are easily stripped.

NOTE

When resoldering the two wires, it is important that they be twisted.

Turret Assembly Removal (A1A4)

1. Remove the RF Section Assembly (Service Sheet B) and RF Section cover (procedure given above).
2. Remove heat sink on transistor A1A3Q3.
3. Disconnect W1 from A1A3J1 (8).
4. Loosen two setscrews (148) that secure turret to Turret Assembly Shaft (95).
5. Turn turret halfway between ranges and gently slide it off of the shaft.

CAUTION

Do not lift or pull the Turret Assembly by the inductor coils. Be careful not to snag the coils on the RF Oscillator Board.

Turret Assembly Installation (A1A4)

1. If the Frequency Tune capacitor or FM Modulator Board Assembly (15) has been removed, it must be installed before installation of the Turret Assembly.
2. If the RF Oscillator is in place, remove the heatsink on A1A3Q3 and remove W1 from A1A3J1 (8).

Power Supply Circuits (P/O A3, P/O A5)
SERVICE SHEET 7

SERVICE SHEET A (Cont'd)

3. With the Turret Assembly (146) held in mid-range position, carefully press it onto the Turret Assembly Shaft (95). The turret's metal ring should mate with the contact (151).

CAUTION

Do not lift or pull the Turret Assembly by the inductor coils. Be careful not to snag the coils on the RF Oscillator Board.

4. Turn frequency dial to 270—520 MHz range. Turn turret so that the inductor pins for 270—520 MHz range are touching the capacitor contacts (inductor is metal plate, no wire). Center inductor pins (in two planes) on capacitor contacts and tighten two allen setscrews to shaft.
5. Check all ranges for proper contact of the inductor pins with the capacitor contacts. The minimum deflection of the contacts on any range should be greater than or equal to 0.8 mm (1/32 inch). If adjustment is required, loosen two pan-head screws (27) on capacitor bracket and two pan-head screws (13) on FM Modulator Board bracket. Make adjustment by moving entire capacitor assembly just enough so that the contact deflection is as described above for all ranges.
6. Replace heatsink on A1A3Q3 and reconnect W1 to A1A3J1.

FM Modulator Board Assembly Removal (A1A2)

1. Remove RF Section Assembly (Service Sheet B), the RF Section cover, and the Turret Assembly (procedures given above).
2. Remove two pan-head screws (13) with star washers and four flat washers (14, 16).
3. Remove two hex nuts (9) and lockwashers (11).
4. Unsolder two wires and remove board.

FM Modulator Board Assembly Insallation (A1A2)

1. If the Frequency Tune capacitor (19) has been removed, it must be installed before installation of the FM Modulator Board Assembly (15).
2. Install the FM Modulator Board Assembly by reversing the procedures for removal.

CAUTION

Do not overtighten the hex nuts (9). The mounting studs are easily stripped.

Frequency Tune Capacitor Removal (A1C3)

1. Remove RF Section Assembly (Service Sheet B) and the RF Section cover, the RF Oscillator Board Assembly, the Turret Assembly, and the FM Modulator Board Assembly. The procedures are given above.
2. In order to prevent the need to restring the dial, securely tape the dial cord to the tuning capacitor pulley (22).
3. Loosen two allen setscrews (20) that secure the pulley to the tuning capacitor shaft and lift pulley off. (Position pulley to maintain cord tension.)
4. Remove two pan-head screws (21) and lock nuts (26) at the capacitor mounting bracket (25) and remove capacitor.

Frequency Tune Capacitor Installation (A1C3)

1. Install the Frequency Tune Capacitor by reversing the procedures for removal.

Rotary P.C. Switch Assembly Removal (A1A5)

1. Remove RF Section Assembly (Service Sheet B).
2. Remove one pan-head screw (85) and lockwasher (84) that secure A1A5 assembly to the frequency plate (88).
3. Remove one self-locking machine screw (69) that secures the switch shaft to the dial drum shaft (125). Remove A1A5 assembly.

Rotary P.C. Switch Assembly Installation (A1A5)

1. Install the Rotary P.C. Switch Assembly by reversing steps 2 and 3 of the removal procedure.
2. Set FREQUENCY RANGE (MHz) to the 10—19 MHz range. Loosen the self-locking machine screw (69) in the rotary switch shaft and set the spring contacts on the switch rotor straight up (instrument in normal operating position).
3. Tighten the shaft screw (69) and reinstall the RF Section assembly (Service Sheet B).

A1 RF Section Assembly Legend (Service Sheet A)

Item No.	Reference Designator	Description
1	A1MP50	RF Section Cover
2	A1MP19	Back Damp Pad
3	A1MP20	Cover Damp Pad
4	A1MP126	Hex Nut
5	A1W1	Pickup Cable Assembly
6	A1MP107	Lock Washer
7	P/O A1W1	Ferrite Washer
8	A1A3J1	RF Jack
9	A1MP115	Hex Nut
10	A1A3	RF Oscillator Board Assembly
11	A1MP22	Lock Washer
12	A1MP44	Flat Washer
13	A1MP100	Machine Screw
14	A1MP102	Flat Washer
15	A1A2	FM Board Assembly
16	A1MP102	Flat Washer
17	A1MP72,73	Capacitor Contact
18	A1MP52,53	Capacitor Damp Pad
19	A1C3	Variable Capacitor
20	A1MP129	Setscrew
21	A1MP101	Machine Screw
22	A1MP74	Capacitor Drive Pulley
23	A1MP56	Nylon Cord
24	A1MP17	Extension Spring
25	A1MP128	Capacitor Mount Bracket
26	A1MP104	Hex Nut with Lock Washer
27	A1MP105	Machine Screw
28	A1MP103	Flat Washer
29	A1MP101	Machine Screw
30	A1MP103	Flat Washer
31	A1MP106	Metal Cable Clamp
32	A1MP1	Solder Lug
33	A1MP109	Flathead Screw
34	A1C2	Capacitor
35	A1FL2	Feedthru Filter
36	A1FL8	Feedthru Filter
37	A1FL1	Feedthru Filter
38	A1C4	Capacitor
39	A1MP82	Feedthru Shield
40	A1L2	Inductor
41	A1R1	Resistor
42	A1L1	Inductor
43	A1MP114	Machine Screw
44	A1MP62	Pulley Bracket
45	A1MP69	Braid Clamp
46	A1MP109	Flathead Screw
47	A1MP116	Machine Screw
48	A1MP54	RFI Braid
49	A1FL7	Feedthru Filter
50	A1FL6	Feedthru Filter
51	A1FL4	Feedthru Filter
52	A1C1	Feedthru Capacitor
53	A1FL5	Feedthru Filter
54	A1FL3	Feedthru Filter

A1 RF Section Assembly Legend (Service Sheet A)

Item No.	Reference Designator	Description
55	A1MP43	Spring Washer
56	A1MP39	Flat Washer
57	A1MP8	Retainer Ring
58	A1MP63	Pulley Bracket
59	A1MP116	Machine Screw
60	A1MP84	Cursor Guide Rod
61	A1MP85	Cursor Guide Rod
62	A1MP124	Nylon Cable Clamp
63	P1	Terminal Board
64	A1MP4	Push On Retainer
65	A1MP5	Push On Retainer
66	A1A5	Rotary P.C. Switch Assembly
67	A1A5MP2	Spring Washer
68	A1A5MP3	Retainer Ring
69	A1MP125	Machine Screw
70	A1A5MP4	Flat Washer
71	A1A5MP4	Flat Washer
72	A1A5MP4	Flat Washer
73	A1MP122	Hex Nut
74	A1MP103	Flat Washer
75	A1MP100	Machine Screw
76	A1MP123	Cable Tie
77	A1MP93	Dial Drum
78	A1MP60	Cursor
79	A1MP77	Frequency Shaft
80	A1MP94	Setscrew
81	A1MP127	Setscrew
82	A1MP18	Ball Drive
83	A1MP3	Solder Lug
84	A1MP98	Lock Washer
85	A1MP97	Machine Screw
86	A1MP121	Machine Screw
87	A1R2	Potentiometer
88	A1MP78	Frequency Plate
89	A1MP117	Machine Screw
90	A1MP70	Potentiometer Mounting Bracket
91	A1MP119	Lock Washer
92	A1MP118	Hex Nut
93	A1MP120	Set Screw
94	A1MP75	Potentiometer Drive Pulley
95	A1MP92	Turret Shaft Assembly
96	A1MP29	Hex Nut
97	A1MP101	Machine Screw
98	A1MP24	Lock Washer
99	A1MP10	Flex Tubing
100	A1MP2	Solder Lug
101	A1MP30	Hex Nut
102	A1MP98	Lock Washer
103	A1MP97	Machine Screw
104	A1MP112	Flat Washer
105	A1MP58	Leaf Spring
106	A1MP25	Lock Washer
107	A1MP57	Detent Roller
108	A1MP59	Detent Spring

A1 RF Section Assembly Legend (Service Sheet A)

Item No.	Reference Designator	Description
109	A1MP83	Base Plate
110	A1MP86	Counter Gear Shaft
111	A1MP9	Spring Pin
112	A1MP40	Flat Washer
113	A1MP65	Pulley Bracket
114	A1MP42	Spring Washer
115	A1MP6	Push On Retainer
116	A1MP7	Push On Retainer
117	A1MP38	Spring Washer
118	A1MP116	Machine Screw
119	A1MP64	Pulley Bracket
120	A1MP91	Counter Shaft Assembly
121	A1MP116	Machine Screw
122	A1MP41	Flat Washer
123	A1MP108	Grip Ring
124	A1A1J3	RF Jack
125	A1MP89	Dial Drive Assembly
126	A1MP111	Flathead Screw
127	A1MP110	Machine Screw
128	A1MP23	Lock Washer
129	A1MP68	Feedthru Shield Gasket
130	A1MP101	Machine Screw
131	A1A1J2	RF Jack
132	A1MP71	RF Amplifier Cover
133	A1MP81	RF Amplifier Divider
134	A1MP109	Flathead Screw
135	A1MP79	RF Amplifier End Plate
136	A1A1J1	RF Jack
137	A1A1	RF Amplifier Board Assembly
138	A1MP80	RF Amplifier Shield
139	A1MP76	Output Amplifier Bushing
140	A1MP26	Lock Washer
141	A1MP101	Machine Screw
142	A1MP31	Hex Nut
143	A1MP67	Feedthru Shield Gasket
144	A1MP115	Hex Nut with Lock Washer
145	A1MP66	Oscillator Chassis
146	A1A4	Turret Assembly
147	A1MP100	Machine Screw
148	A1A4MP1	Setscrew
149	A1MP109	Flathead Screw
150	A1MP27	Non-Metallic Washer
151	A1MP61	Contact
152	A1MP87	Threaded Plug
153	A1MP11	Flex Tubing
154	A1MP32	Setscrew
155	A1MP48	Silicon Rubber Damp Pad
156	A1MP14	Bushing
157	A1MP36	Flat Washer
158	A1MP55	Braid
159	A1MP96	Lock Washer
160	A1MP99	Machine Screw
161	A1MP95	Machine Screw
162	A1MP88	Threaded Plug

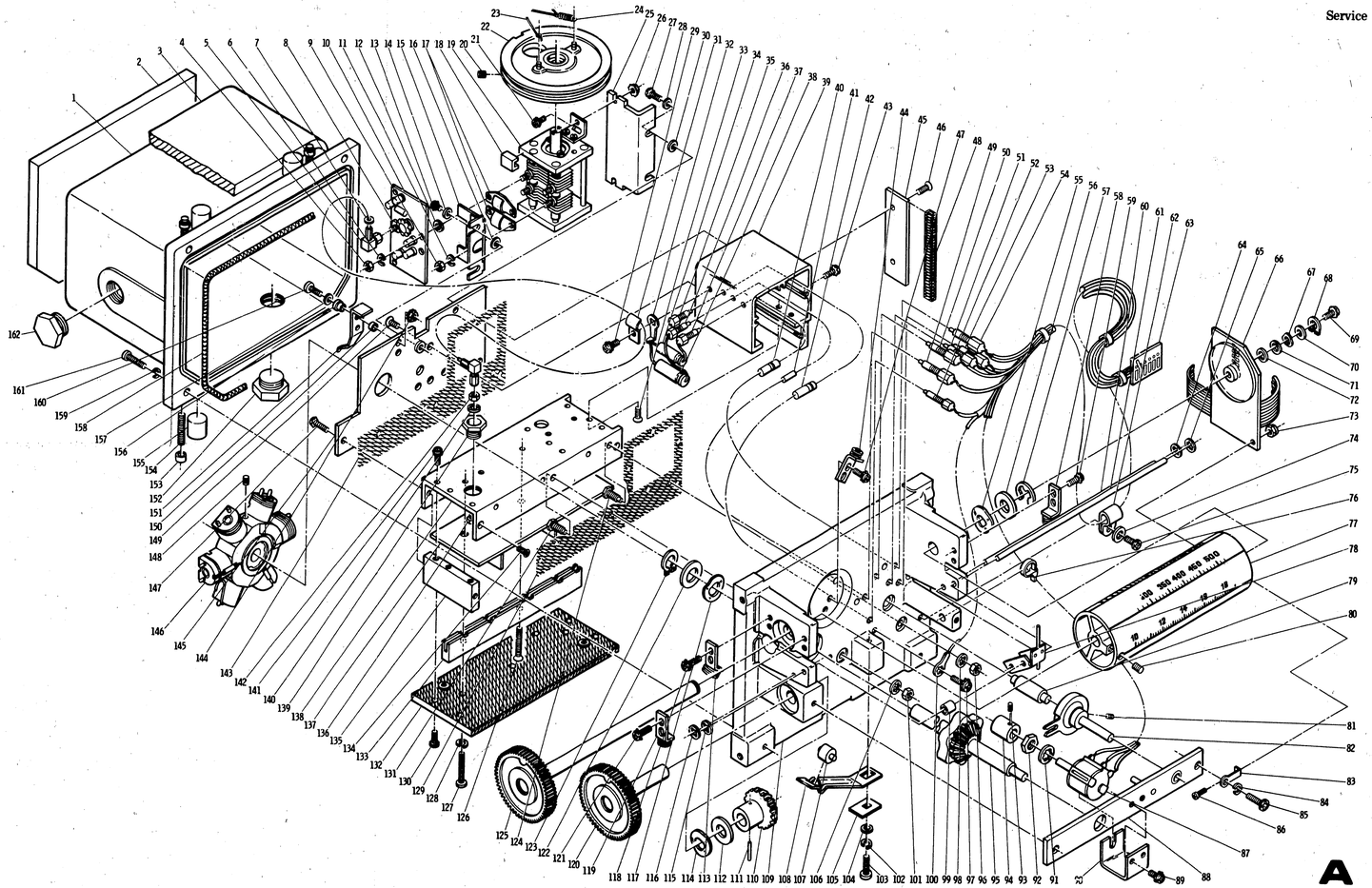
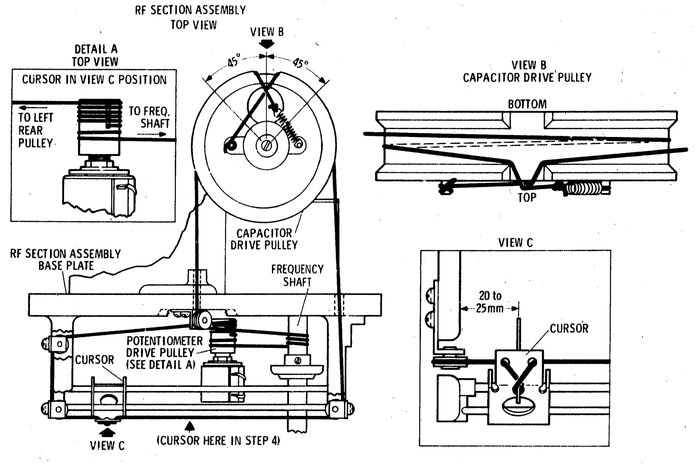


Figure 8-24. RF Section Assembly Illustrated Parts Breakdown



1. Remove RF Section Assembly (Service Sheet B), RF Section cover, and A1A5 Rotary P.C. Switch Assembly (Service Sheet A). Remove retainer ring, flat washer, and spring washer at right end of dial drum shaft. Loosen dial drum setscrew and remove shaft and drum. (Item numbers in parentheses refer to Figure 8-24.)

2. Remove screws (89) securing potentiometer bracket (90) to frequency plate. Remove pot drive pulley (secured by two setscrews) and turn pot fully cw. Loosen setscrews securing frequency tune capacitor pulley (22) and turn capacitor fully cw. Cut 1.3 mm (5½ ft.) of dial cord (A1MP56). Tie two large knots 12 mm (½ in.) apart midway in the cord. Insert cord in pot drive pulley slot, capturing knots in center hole.

3. Grasp pot drive pulley at slotted end. Wind one end of cord three full turns cw around pulley. Grasp pulley at unslotted end keeping previous turns in place. Wind other length of cord four full turns cw around pulley and fix turns to pulley with tape. Mount pulley on pot shaft so that pulley slot will be horizontal when installed pot is fully cw. Tighten one pulley setscrew and reinstall pot.

4. Route 4-turn end of cord around two left side pulleys to cursor, pinching the cord between the pulleys and their brackets to maintain tension. With cursor positioned just left of center track, feed cord through left cursor hole, 2 turns cw around pin, and through right cursor hole (see View C). Pinch cord between right side pulley and bracket through hole in base plate to frequency tune (large) pulley. Set large pulley so gap in upper edge is 45–90° ccw from position shown in figure above. Wind cord around pulley to the gap and tie cord to pin securely with a figure-eight knot. The gap should be 45° ccw from position shown above when cord is taut. Tighten one setscrew on large pulley to hold cord taut.

5. Feed second length of cord from pot pulley 2½ turns cw and around frequency shaft, placing each turn behind last. Route cord behind green wire soldered to A1FL7, around center pulley, through hole in base plate to frequency tune pulley. Wind cord one full turn cw around pulley to pulley gap. This turn should pass under the other end of cord but over its own previous turn (see View B). Tie cord to spring and hook spring on pin. Cord should have light tension throughout.

6. Loosen setscrew in large pulley and lift pulley off capacitor shaft to relieve cord tension slightly. Set cord previously pinched between pulleys and brackets onto pulleys. Replace large pulley on capacitor shaft, relieving cord tension by extending spring.

7. Loosen potentiometer pulley setscrew and remove tape over windings. Tune cursor to right end of track. Insert allen driver into set screw in pot pulley and apply slight tension as if to tune cursor beyond stop. Tighten both setscrews. (This assures pot does not reach its cw stop when cursor is tuned to high end of range.)

8. Replace dial drum and Rotary P.C. Switch Assembly. Perform Tuning Capacitor Pulley Adjustment (paragraph 5-21), and Frequency and Range Adjustment (paragraph 5-22). Replace RF Section cover and perform all FM adjustments (paragraphs 5-23 through 5-25).

Figure 8-25. Model 8654B Dial Stringing Procedure

SERVICE SHEET B

A1 RF Section Removal and Installation Procedures

1. Remove all four instrument covers by removing 14 flat-head screws. The covers are shown in Figure 6-1 (MP's 1, 5, 8, and 11).

2. Remove A5 FM Driver Board Assembly by carefully disconnecting the ribbon cable connectors (at A5J1 and A5J2), and extracting the board from the 18-pin edge connector. The pins on the ribbon cable connectors are easily bent and should be protected whenever removed from their sockets.

3. Loosen two machine screws that secure the meter bracket. Remove one flat-head screw from the top of the trim strip and one machine screw from each end of the strip. Carefully lift strip with meter off of the instrument. Be sure the meter index is free of its hole in the right side frame assembly. Slide meter off of trim strip and return it to the instrument.

CAUTION

Since the meter is not secured, care must be taken that it does not fall out when the instrument is tilted.

5. Remove the FREQUENCY RANGE and TUNE knobs from the front panel by loosening two allen screws each.

6. Disconnect semi-rigid cables W2 at J5 and W4 at A2J1 using the combination wrench supplied with the instrument.

7. Remove two pan-head screws and lockwashers that secure the FM Driver Board support bracket. Remove bracket.

8. Remove two flat-head screws from each end of the top RF Section Assembly support bar, and remove bar.

CAUTION

Bars on top and bottom of instrument support the full weight of the RF Section Assembly. To avoid damaging stress to semi-rigid coaxial cables W2 and W4, disconnect cables at J5 and A2J1 before removing support bars.

9. Disconnect 12-pin printed circuit card from J1.

10. Remove two flat-head screws from each end of the bottom RF Section Assembly support bar and remove bar.

RF Section Assembly Illustrated Parts Breakdown (A1A1) and Disassembly Procedures
◀ SERVICE SHEET A

SERVICE SHEET B (Cont'd)

11. Carefully lift out RF Section Assembly.

NOTE

Whenever RF Assembly is out of the instrument, take care not to bend dial cursor. It is also recommended that semi-rigid coaxial cables W2 and W4 be disconnected from the RF Assembly (at A1A1J2 and A1A1J3).

RF Section Assembly Installation

CAUTION

While working with and around the semi-rigid coaxial cables in the generator, do not bend the cables more than necessary. Do not torque the RF connectors to more than 0.5 Nm (5 inch-pounds).

MICROPHONICS

To minimize the possibility of microphonics in the generator, perform steps 1 and 2 before installing the RF Section Assembly.

1. Check that semi-rigid coaxial cables W2 and W4 are firmly connected to A1A1J2 and A1A1J3.

2. Check that the four large pan-head screws that secure the RF Section Assembly cover are tight.

3. Install RF Section Assembly in the generator by performing steps 2 through 11 of the removal procedure in reverse order.

MICROPHONICS

To minimize the possibility of microphonics in the generator, perform steps 4 through 7 before replacing the instrument covers.

4. Check that four rubber damper pads are in place in the top and bottom support bars.

5. Check that semi-rigid coaxial cables W2 and W4 are firmly connected at J5 and A2J1. The cables should not be touching the RF assembly casting, the Attenuator assembly casting, or the FM Driver Board Support bracket. The cables should be wrapped together at approximately 50 mm (2-inch) intervals.

6. Check that the FM Driver Board bracket holds the FM Driver Board securely. If not, lift the board and press the bracket in. However, the bracket must not touch the semi-rigid coaxial cables or the RF connectors.

7. Check that the FREQUENCY RANGE and Tune knobs do not touch the front panel as they turn through their range.

8. Replace the four instrument covers ensuring that all screws are tight.

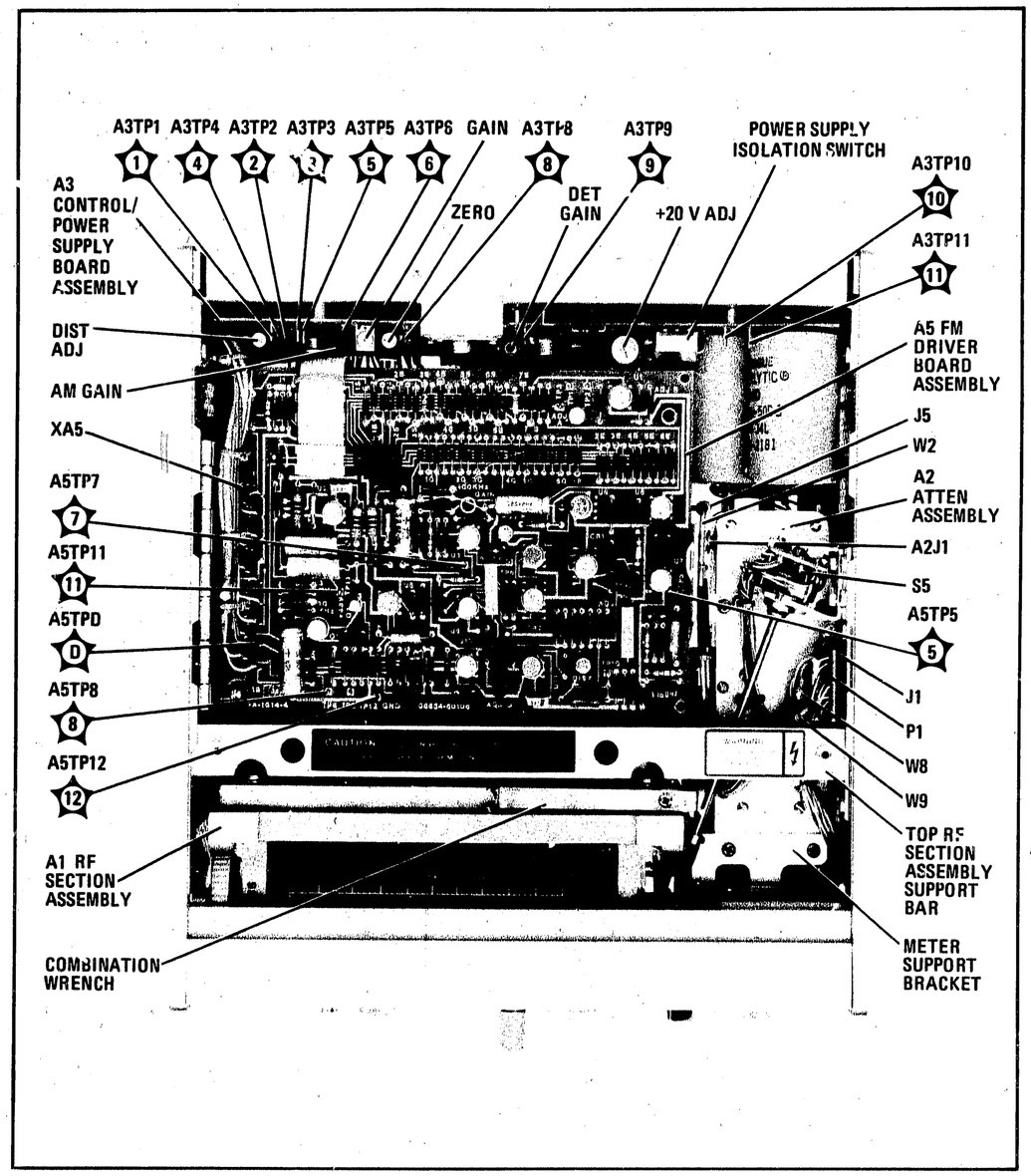


Figure 8-26. Top Internal View

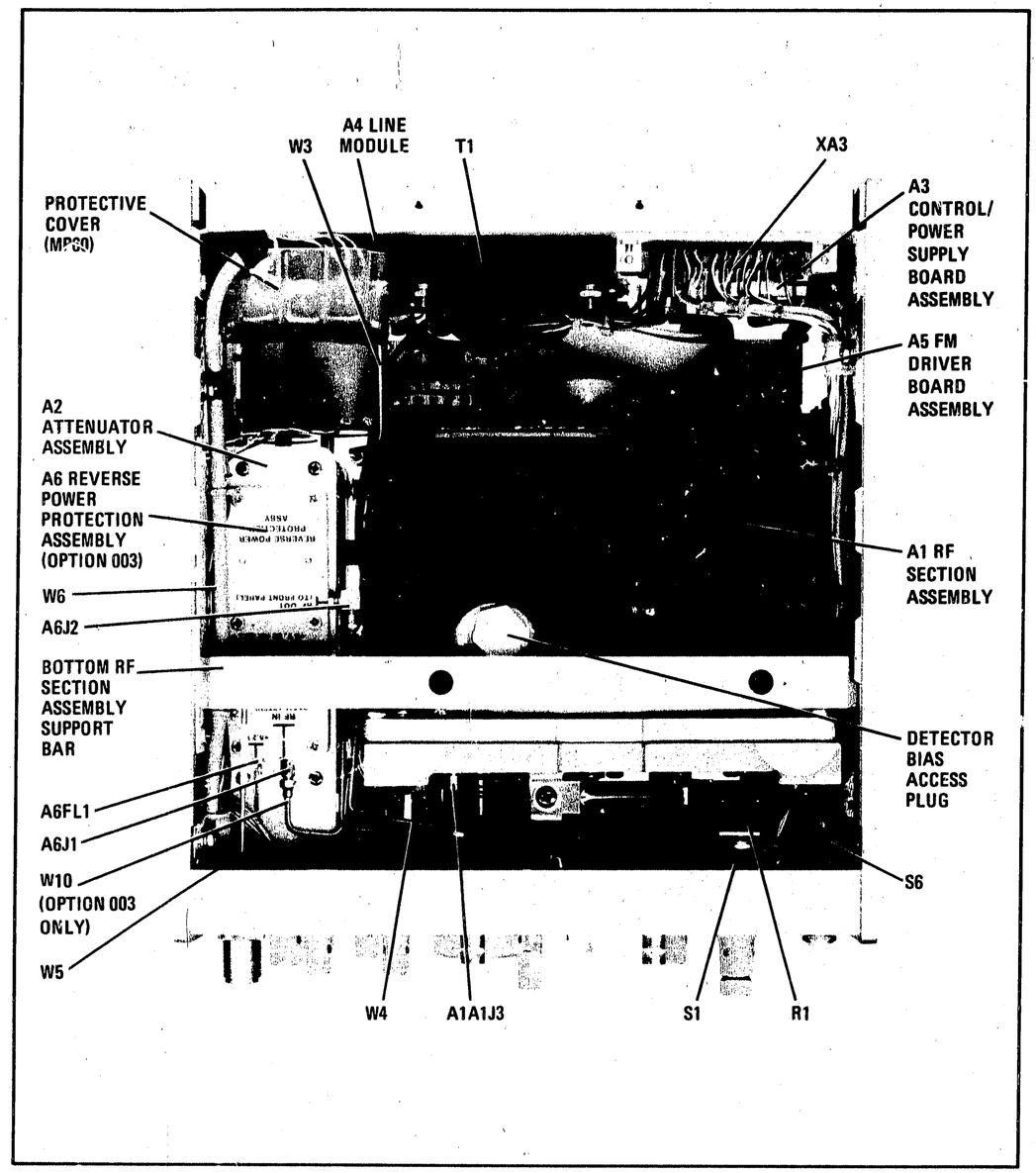


Figure 8-27. Bottom Internal View (Option 003 Shown)

MANUAL CHANGES

MANUAL IDENTIFICATION
Model Number: 8654B
Date Printed: March 1977
Part Number: 08654-90025

SIGNAL GENERATOR

This supplement contains important information for correcting manual errors and for adapting the manual to instruments containing improvements made after printing the manual.

To use this supplement, first, make all ERRATA corrections and then all appropriate serial number related changes indicated in the tables below.

SERIAL PREFIX OR NUMBER	MAKE MANUAL CHANGES
1811A	1
1842A	1-2
1844A	1-3
1849A	1-4
1920A	1-5
2011A	1-6
2121A	1-7
2231A	1-8
2249A	1-9
2315A	1-10
2339A	1-11
>> 2341A	1-12

SERIAL PREFIX OR NUMBER	MAKE MANUAL CHANGES

>> NEW ITEM

NOTE:
Manual change supplements are revised as often as necessary to keep manuals as current and accurate as possible. Hewlett-Packard recommends that you periodically request the latest edition of this supplement. Free copies are available from all HP offices. When requesting copies, quote the manual identification information from your supplement or the model number and print date from the title page of the manual.

Printed in U.S.A.

HEWLETT PACKARD

01 January 1984
9 Pages Text
2 Pages Illustrations

ERRATA

Page i, Title Page:

Under **SERIAL NUMBERS**, change the first sentence to read as follows: This manual applies directly to instruments with serial numbers prefixed 1710A and 1733A.

Page 1-4, Table 1-1:

Under **Frequency Modulation**, change the **External FM Sensitivity** specification to read:

External FM Sensitivity (with FM vernier fully clockwise):[2]
1 volt peak into 600 ohms yields maximum peak deviation as indicated in table below.

FM Range (kHz)	Meter Scale	Maximum Peak Deviation (kHz)
3	0-3	3.16
10	0-10	10
30	0-3	31.6
100	0-10	100

Under **GENERAL CHARACTERISTICS**, change Power specifications to read:
Power: 100 or 120 volts (+5%, -10%) from 48 to 440 Hz; or 220 or 240 volts (+5%, -10%) from 48 to 66 Hz. Power consumption is 25 VA maximum. 2.29m (7 1/2 ft) power cable furnished with mains plug to match destination requirements.

Page 2-1, paragraph 2-7:

Change the first sentence to read:
"The 8654B Signal Generator requires a power source of 100 or 120 volts (+5%, -10%) from 48 to 66 Hz, single phase."

In Figure 2-1, add the following after the third sentence:

WARNING

To avoid the possibility of hazardous electrical shock, do not operate this instrument at line voltages greater than 126.5 Vac with line frequencies greater than 66 Hz (leakage currents at these line settings may exceed 3.5 mA).

ERRATA (cont'd)

>> Page 2-1, Paragraph 2-9:
Add the following under NOTE:

Two fuses are supplied with each instrument. One fuse has the proper rating for 110/120 Vac line operation; the other fuse is rated for 200/220 Vac operation.

One fuse is installed in the instrument at the time of shipment. The rating of the installed fuse is selected according to the line voltage specified by the customer. If the voltage is not specified, the rating of the installed fuse will be selected according to the country of destination.

Page 5-15, paragraph 5-23:
Add the following as step 10:
"10. Remove jumper wire between A5TP8 and A5TP12."
In step 11, change the voltmeter reading to 0.60 ± 0.10 Vdc.
In step 12, change the adjustment voltage to 0.00 ± 0.10 Vdc.
In step 16, change the voltage at A5TP8 to ± 0.10 Vdc.

Page 6-6, Table 6-2:
Delete the A1A1 08654-60022 and 08654-60051 listings. (Restored 08654-60022 and 08654-60051 Board Assemblies no longer available).
A1A1: For recommended replacement, see CHANGE 3.

NOTE

When replacing A1A1, part number 08654-60002 or 08654-60050, replace RF Amplifier Cover, A1MP71 and order associated hardware A1MP130, A1MP131 and A1MP132. See CHANGE 3 for part numbers.

A1A1C1-3,5,6,11,13-15,17,18,22: For recommended replacement, see CHANGE 10.

A1A1Q6: For recommended replacement, see CHANGE 11.

Page 6-10, Table 6-2:
A3U3: Change Part Number to 1826-0092 and under the Description add: (recommended replacement).
A3U4: For recommended replacement, see CHANGE 10.

Page 6-13, Table 6-2:
>> A5U1 and A5U8: For recommended replacement, see CHANGE 10.
>> A5U10: For recommended replacement, see CHANGE 12.

>> Page 6-15, Table 6-2:
Change R1 to HP Part Number 2100-2063 (CD5) RESISTOR-VAR CONTROL CCP 1K 10% LIN.

Page 6-17, Table 6-2:
Add MP67 08654-00057 COVER, TRANSFORMER (MP66 not assigned).
Add MP68 7120-7032 LABEL, SAFETY (CD5).
MP26: Change Part Number to 0370-3051.
MP39: For recommended replacement see CHANGE 9.

ERRATA (cont'd)

Page 8-19, Figure 8-15, Service Sheet 4 (schematic):
In the lower right hand portion of the schematic change the off-page indicator 3 U to 3 H.
In the center portion change U3A part number to 1826-0092.

Page 8-23, Figure 8-19:
P/O A5 FM Driver Board Assembly Component Locations. In the center of the board, change the following designations:
R52 becomes R54
R51 becomes R52
R54 becomes R51

Page 8-23, Figure 8-20, Service Sheet 6 (schematic):
Add pin number "11" to the junction of A5J2 and A1A5P2 for the line labeled "+29.4V R ".

CHANGE 1

Page 6-9, Table 6-2:
Make the following changes to the A3 listings:
Add A3C30 0180-2214 CAPACITOR-FXD 90 UF +75 -10% 16 VDC AL.
Delete CR1 and CR2.
Add CR19-CR26 1901-0327 DIODE-PWR RECT 200V 1A 6US.

Page 8-25, Service Sheet 7 (component locations):
Replace Figure 8-21 with the attached Figure 8-21. P/O A3 Control Power Supply Board Assembly Component Locations (P/O CHANGE 1).

Page 8-25, Service Sheet 7 (schematic):
Make the following changes to the A3 Assembly.
Add C30, 90 uF, across VR2 with the positive polarity connected to the +5.2V line.
Delete the dashed line around CR1 and CR2.
Change the reference designators of CR1A-D and CR2A-D to the following:
Change CR1A to CR19.
Change CR1B to CR20.
Change CR1C to CR21.
Change CR1D to CR22.
Change CR2A to CR23.
Change CR2B to CR24.
Change CR2C to CR25.
Change CR2D to CR26.

CHANGE 2

Page 6-9, Table 6-2:
Change A3C12 to 0180-1746 CAPACITOR-FXD 15 UF ± 10% 20 VDC TA (CD5).

Page 8-25 Service Sheet 7 (schematic):
Change A3C12 to 15 uF.

CHANGE 3

Page 5-2, Table 5-1:

Reference Designator	Basis of Selection	Normal Value Range	Service Sheet
A1A1C4 and A1A1L3	(See A1A3C6 selection.) If the A1A1 RF Amplifier Assembly has been repaired, selection of A1A1C4 and L3 may be necessary in order to achieve the proper RF output level. Check the output level at the rear panel AUX RF OUT connector. If the output level at the high end of the 270-520 MHz range is lower than the published specification, adjust A1A1L3 by increasing the spacing between its turns, which increases the power output. Adjust A1A1L3 until the AUX RF OUT level is just within specified limits. Excessive power may cause the second harmonic to be out of specification. If after adjusting the inductor, the level is still out of specification, increase A1A1C4 one standard value and repeat adjustment of A1A1L3. Perform Harmonic Distortion Test (paragraph 4-14) and Output Level Flatness Test (paragraph 4-18).	0-6.8 pF	3

Page 6-5, Table 6-2:
Change A1MP71 to 08654-00060 (CD4).

Page 6-6 and 6-7, Table 6-2:
Add A1MP130 0520-0130 SCREW-MACH 2-56 .375-IN-LG PAN-HD-POZI (CD1).
Add A1MP131 2190-0890 WASHER-LK HLCL NO.2 .088-IN-ID (CD1).
Add A1MP132 3050-0098 WASHER-FL MTCL NO.2 .094-IN-ID (CD6).
Change A1A1 (08654-60002) to 08654-60092.
Change A1A1 (08654-60050) to 08654-60093.
Change A1A1C4 to 0160-3872 CAPACITOR-FXD 2.2 PF 25 PF 200 VDC CER (CD0).
Add A1A1CR6 and CR7 1901-0050 DIODE SWITCHING 80V 200 MA 2NS DO-35 (CD3).
Change A1A1L3 to 08654-80002 INDUCTOR RF 35 NH (CD2) and add an asterisk (indicating a factory selected value).
Under A1A1Q4, Q5, Q6, and Q7, change 1205-0037 to 1205-0358 THERMAL LINK SGL TO-18-PKG (CD8).
Add A1A1VR1 and VR2 1902-0579 DIODE-ZNR 5.11V 5% DO-15 PD=1W TC=.009% (CD3).

Page 6-17, Table 6-2:
Change MP60 to 4040-1083 COVER POWER MODULE (CD8).

CHANGE 3 (cont'd)

Page 8-15, Service Sheet 3 (component locations):
Replace Figure 8-10 with the attached Figure 8-10. A1A1 RF Amplifier/ALC Board Assembly Component Locations (P/O CHANGE 3).
Page 8-15, Service Sheet 3 (schematic):
Change A1A1C4 to 2.2 pF.
Change A1A1L3 to 3.5 nH and add an asterisk (indicating factory selected value).
Replace appropriate portion of the schematic diagram with the attached partial schematic. P/O Figure 8-11. RF Amplifier/ALC Assembly Schematic Diagram (P/O CHANGE 3).
Page 8-26, Service Sheet A (A1 RF Section Disassembly and Reassembly Procedures):
Under RF Amplifier/ALC Board Assembly Removal (A1A1), add the following as the first sentence in step 2:
"Remove four machine screws (123A) with washers (123B, 123C) that secure the thermal links to the RF Amplifier cover.
Under RF Amplifier/ALC Board Installation (A1A1), add the following as the second sentence in step 8:
"Replace and tighten the four machine screws (123A) with washers (123B, 123C) that secure the thermal links to the RF Amplifier cover."
Page 8-27, Service Sheet A (legend):
Add the following to the A1 RF Section Assembly legend:
Item Number 123A A1MP130 Machine Screw.
Item Number 123B A1MP131 Lock Washer.
Item Number 123C A1MP132 Flat Washer.
Page 8-27, Service Sheet A, Figure 8-24:
Replace appropriate portion of Figure 8-24 with the attached partial figure, P/O Figure 8-24. RF Section Assembly Illustrated Parts Breakdown (P/O CHANGE 3).

CHANGE 4

Page 6-15, Table 6-2:
Change R8 to 0698-3162 46.4K 1% .125W F TC=0±100 (CD0).
Page 8-25, Service Sheet 7 (schematic):
Change R8 to 46.6k.

CHANGE 5

Page 6-15, Table 6-2:
Change S1 to 3101-0415 SWITCH-SL DPDT MINTR .5A 125 VAC/DC (CD0).

CHANGE 6

Page 6-10, Table 6-2:
Change A3U4 to 1826-0547 IC OP AMP DUAL 8-DIP-8 (CD3).
Page 6-13, Table 6-2:
Change A5U1, U8 and U10 to 1826-0547 IC OP AMP DUAL 8-DIP-8 (CD3).
Page 8-19, Service Sheet 4 (schematic):
Change A3U4 to 1826-0547.
The physical location of capacitor C1 has been changed. C1 is no longer soldered directly to switch S1, but is now mounted on a solder lug which is attached to the Attenuator support bracket.

NOTE

This change does not affect the schematic diagram.

Page 8-21. Service sheet 5 (schematic):
Change A5U1 to 1826-0547.
Page 8-23, Service Sheet 6 (schematic):
Change A5U8 and A5U10 to 1826-0547.

CHANGE 7

Page 6-6, Table 6-2:
Add A1A1E1 9170-0847 FERRITE BEAD (CD3).
Page 6-10, Table 6-2:
Change A3R44 to 0698-3159 RESISTOR 26.1K .125W F TC=0+100 (CD5).
Change A3R45 to 2100-3355 RESISTOR TRMR 100K 10% C SIDE ADJ 1-TRN (CD0).
Page 8-15, Service Sheet 3 (schematic):
Add A1A1E1 ferrite bead on the Q4 end of R14.
Page 8-19, Service Sheet 4 (schematic):
Change A3R44 to 26.1k.
Change A3R45 to 100k.

CHANGE 8

Page 6-14, Table 6-2 (Replaceable Parts):
Delete A6A1R6, part number 0633-0275.
Add A6A1L3 9100-2249 INDUCTOR RF-CH-MLD 150 NH 10% .105DX.26LG (CD1).
Page 8-17, Service Sheet 3A (schemtic):
In "LIMITER" portion of A6A1 REVERSE POWER PROTECTON BOARD ASSEMBLY Schematic, replace 2.7 ohm resistor R6 with 150 nH inductor L3.
Replace R6 in A6A1 Component Locator (Figure 8-12) with L3.

CHANGE 9

Page 6-17, Table 6-2:
Change MP39 to 0370-3056 KNOB (FREQUENCY RANGE).

CHANGE 10 - Serial Prefix 2315A

Page 6-6, Table 6-2:
Change A1A1C1-3,5,6,11,13-15,17,18,22 to HP Part Number 0160-5759 (CD6) CAPACITOR-FXD .01UF +-20% 100VDC CER.
Change A1A1C7 to HP Part Number 0160-4077 (CD9) CAPACITOR-FXD .01UF +-20% 50VDC CER.

Page 6-10, Table 6-2:
Change A3U4 to HP Part Number 1826-0785 (CD1) IC OP AMP LOW-BIAS-H-IMPD DUAL 8-DIP-C.

Page 6-13, Table 6-2:
Change A5U1,8 and 10 to HP Part Number 1826-0785 (CD1) IC OP AMP LOW-BIAS-H-IMPD DUAL 8-DIP-C.

Page 8-19, Service Sheet 4 (schematic):
Change A3U4 to 1826-0785.

Page 8-21, Service Sheet 5 (schematic):
Change A5U1 to 1826-0785.

Page 8-23, Service Sheet 6 (schematic):
Change A5U8,10 to 1826-0785.

CHANGE 11

Page 6-6, Table 6-2:
Change the first A1A1Q6 entry to "5086-4218 HP-21 TO-72 PKG." Delete the phrase, "(OPTION 003 ONLY)."
Delete the second A1A1Q6 entry. Do not delete the A1A1Q6 heat sink entry.

Page 8-15, Service Sheet 3 (schematic):
Under NOTES, change NOTE 5 to read as follows:

5. PART NUMBERS FOR A1A1Q6 AND Q7 ARE:

A1A1Q6
ALL INSTRUMENTS: 5086-4218

A1A1Q7
EXCEPT OPTION 003: 1854-0696
OPTION 003 ONLY: 5086-4218

>> **CHANGE 12**

Page 6-13, Table 6-2:
Change A5U10 to HP Part Number 1826-0111 (CD7) IC OP AMP GP DUAL TO-99 PKG.

Page 8-23, Service Sheet 6 (schematic):
Change A5U10 to 1826-0111.

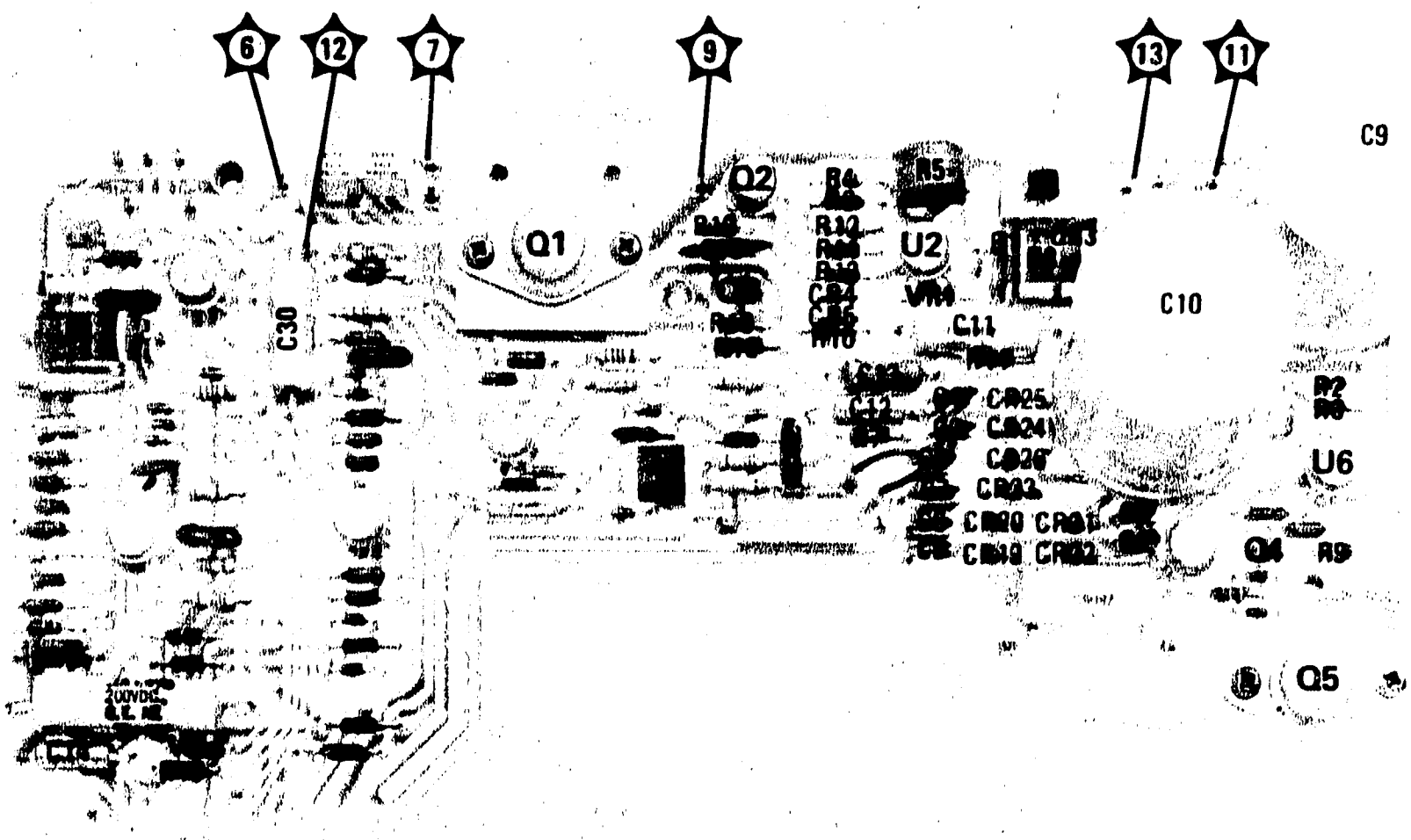


Figure 8-21. P/O A3 Control/Power Supply Board Assembly Component Locations (P/O Change 1)

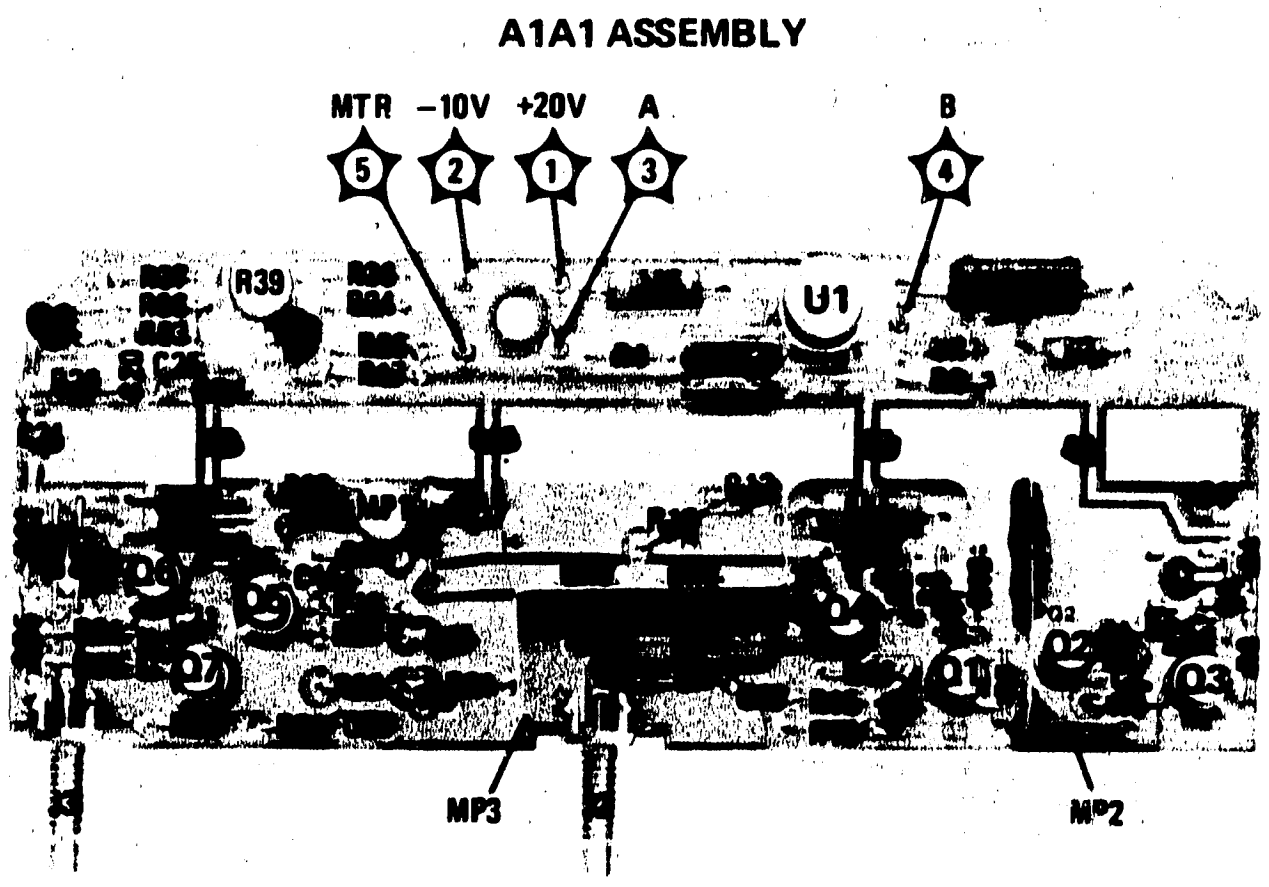
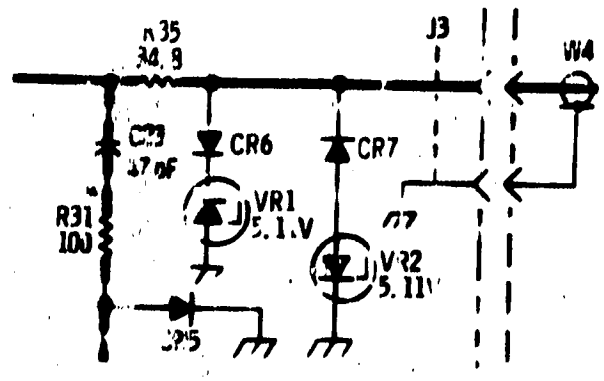
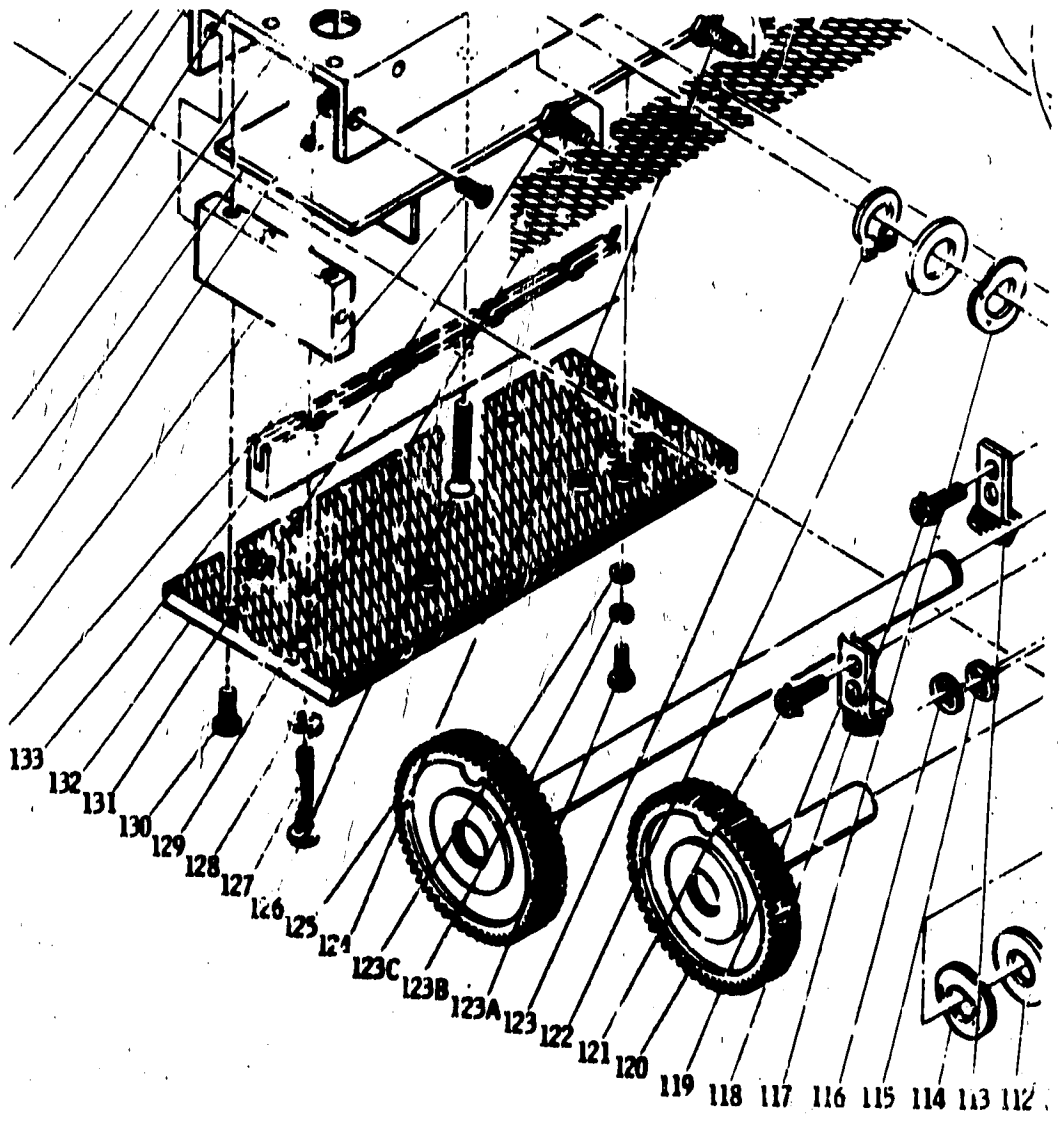


Figure 8-10. A1A1 RF Amplifier/ALC Board Assembly Component Locations (P/O Change 3)



P/O Figure 8-11. RF Amplifier/ALC Assembly Schematic Diagram (P/O Change 3)



P/O Figure 8-19. RF Section Assembly Illustrated Parts Breakdown (P/O Change 3)